

# Man and His Health

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WILLIAM ARMSTRONG FAIRBURN

LIQUIDS



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## LIQUIDS

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BY  
WILLIAM ARMSTRONG FAIRBURN



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*TO MY CO-WORKERS*

whose loyal support and good fellowship  
are a continual source of inspiration



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## INTRODUCTION

**T**HIS volume on "Liquids" is the first completed of three which the author hopes to write on the general subject—"Man and his Health." This work has been prepared with the hope that the scientific truths expounded may be not only of interest but also of benefit to the average reader.

Health is necessary for happiness and there can be no well-being without the enjoyment of good health. Health is man's natural inheritance and if he lives in harmony with nature's laws he will continue in health. Marcus Aurelius wrote, "Man must live in conformity with the laws of nature and nothing can happen to you that is not in accordance with nature's universal law." And Seneca enunciated the maxim, "Take nature for your guide, for so reason bids you and advises you; to live happily is to live naturally."

There was a great deal of sane and healthful optimism in the philosophy of the ancient Greeks and Romans which proclaimed the nobility of humanity and inculcated the doctrine of a harmonious development of human nature, holding that beauty and health were associated with the perfect human body and lasting pleasure the fruit of perfect human action. The Stoics maintained that happiness could not be found except by conforming life to nature. The same principle of a life in harmony with nature led the Epicureans to the con-

clusion that "pleasure is a natural good, that is to say, a condition conformable with nature."

We are accustomed to speak of the "pessimistic philosophies" of the past few centuries, but in regard to our present life and our existence on this planet, has any of the many Schools of Philosophy been as pessimistic as the world's narrow and dwarfing conception of religion? Buddhism has been termed the Religion of Pessimism, but in regard to our physical existence on this earth, the teachings of Buddha are no more pessimistic than our erroneous and warped interpretations of the teachings of Christ. Buddha said, "What wise man having regarded his own body, will not see in it an enemy?" And yet when a young prince, he asked of his father the gift "that he might always remain full of health and that he should be smitten by no disease." His father, the King, replied, "You ask me what is impossible; in that my son I can do nothing." In the sermon of Buddha at Benares he said, "Birth is suffering, old age is suffering, disease is suffering and death is suffering." And we are told that when Buddha escaped from the magnificent palace built for him by his father, where he would be protected from the sorrows of the world, he saw life and reflected thus, "Woe to youth threatened with old age! Woe to health, the prey of every kind of disease! Woe to the life of man which lasts but a little while!" And again, "Health is no more than the idle vision of a dream, while fear and disease are horrible realities. What wise man having seen the thing that life is, can still think of joy or of pleasure? Woe upon health which is assailed by so many maladies." The pessimism of Buddha was therefore founded on the fact that life is relatively

short, that old age follows youth and that disease causes ill health; it was therefore pessimism inspired solely by the restrictions and limitations of life.

Before the dawn of the Christian Era, there were many philosophers who affirmed that man possessed a soul superior to the body which was but its temporary home, and Seneca, the Roman philosopher, a celebrated contemporary of Christ, maintained that the soul must wrestle with the body for the body brings suffering, but the soul is above the body as divinity is above matter. Christ's teachings of immortality and the supremacy of soul over the physical body, unfortunately not being properly understood, resulted in a dualism which led to an outrageous depreciation of the human body. Christians interpreting literally such sayings of Christ as, "Take no thought of your body" and ignoring the deeper spiritual significance of His teachings, declared war against human nature. All pleasures were forbidden, even the most innocent were thought vicious, and the body was shamefully abused by neglect and unnatural suppression. Metchnikoff has said, "The dualistic theory made such demands on its proselytes that these, absorbed in the salvation of their souls, sank from the physical point of view to the level of wild beasts. Hermits resorted to the lairs of animals, abandoned their clothing and went about naked with shaggy and disordered hair. In Mesopotamia and part of Syria there arose a sect of eaters of grass; these were people who had no dwellings and who ate neither bread nor vegetables, but wandered on the hills and fed on the herbage. Cleanliness of the body was regarded as an indication of corruption

of the soul, and among the most highly venerated of the saints were those who took no care of the body."

For many centuries true religion and science have been combating such false views of life, but erroneous ideas, unfortunately merged with Christianity, struck a deep root and many have persisted even to this day. Buckle, in the "History of Civilization in England," says that in the opinion of the Ministers of the Scotch Church of the 17th century there was nothing so surprising as that the earth could contain itself in the presence of that horrid spectacle, man, and that it did not gape to swallow him in his wickedness, for in the created universe there could be nothing so monstrous and so horrible as man. It has been preached that disease is the work of the devil. Martin Luther declared that disease was supernatural in origin, saying, "Behold a matter on which there is no room for doubt and that is that the plague, fevers and other diseases are the work of the devil." The Black Death or Great Plague of the 14th century, which destroyed nearly one-third of the population of Europe, was considered a visitation of the Divine Wrath. We now know that the horrible epidemic was not the manifestation of the anger of God but was a scourge due to man's violation of natural laws. Contamination by filth, and profanation of universal laws of hygiene and sanitation, have caused and continue to cause epidemics of disease, and as a knowledge of scientific hygiene has become disseminated among peoples and been practically applied, so have diseases become less frequent and less destructive.

Humanity has been physically benefitted during the past ages just so far as science, "the daughter of knowledge," has investigated and solved the great

problems affecting mankind, and yet science, though wonderfully successful in probing for truth and teaching us the laws of nature, has been horribly abused. Rousseau expressed the opinion of many of the leaders of his day when he denounced science, saying: "Know, O people, that nature has desired to preserve you from science as a mother tries to snatch a dangerous weapon from the hands of her child; that the secrets which she has hidden from you are evils from which she would preserve you and that one of her greatest gifts, is the difficulty with which knowledge is acquired. Human beings are perverse but they would have been worse had they had the misfortune to be born learned men." Therefore it has been advocated that man should be "steeped in ignorance and superstition," but fortunately science has already done its work so well that only an insignificant small percentage of humanity would agree with Rousseau to-day, that to be learned would be unfortunate. Science and true religion are synonymous and Christ taught not the abuse but the care of the body. He considered the physical body, as did many of the philosophers of His time, as the temple of the soul and as such it should be nurtured, fittingly cared for and maintained at the highest possible degree of efficiency, in order that it might perform its ordained functions in the world and be an instrument used in the progress and development of the world toward the great Cosmic Ideal. Christ did not starve His followers, he fed them. He did not abuse the physical body, but we are told that He healed the sick. His was the true religion of optimism, of hope, of faith and of love. If His teachings had been followed, the pessimism and absurdities of Christianity could

never have existed and civilization would have advanced far beyond the point now realized after nineteen centuries of the Christian Era, of which only a very small portion has been truly progressive. The world must learn that true religion demands the care of the body, that disease comes from the violation of nature's laws and that therefore physical weakness and suffering are not signs of spirituality but rather indications of deplorable error.

The individual in this world cannot live to himself. He is a social creature and his violation of universal laws may affect others seriously as well as himself. The habits and health of the individual may seriously affect the well-being of a community and therefore each individual has a responsibility that extends far beyond himself and his individual body. Darwin defined the term "general good" as the means "by which the greatest possible number of individuals can be reared in full vigor and health, with all their faculties perfect, under the conditions to which they are exposed." Man should see that the conditions of environment, both of himself and his fellow beings, are in general harmony with the laws of nature and if this is impossible, then science must teach how the evil effects of man's insurgency against nature may be overcome by the application of other laws and principles, the secrets of which have been wrestled from Mother Nature. Civilization carries with it an artificiality and an unnatural mode of life which must of necessity be counteracted by science, as man advances in his subjugation of nature. If he fails to protect himself from the boomerang which his progress and development as an aggressive mental creature throw into space, he

will gravitate toward failure and extermination instead of being hailed as a conqueror over all other things, animate and inanimate.

There is an immutable law of the universe known as the Law of Cause and Effect. Modern religions recognize this law which was well expressed by Paul in his Epistle to the Galatians in the words, "Whatsoever a man soweth that shall he also reap." Disease is the result of violation of nature's laws of health. It is the inevitable fruit of error with reference to the maintenance and well-being of the body. Spirituality demands the full and efficient use and not the abuse of the physical body. The tenets of true religion demand that the body be nurtured and cared for, in order that it may fittingly house the soul and serve as an effective instrument of positive service in the world. Suicide is denounced by the Caucasian religions and codes of morals, but there is no difference, as far as the world is concerned, between felonious self-murder and the killing of one's body by persistent abuse and violation of the laws of physical life, whether done voluntarily and intentionally, on the one hand, or in ignorance and indifference, on the other. If the human body is misused and maltreated deliberately, the line of conduct is synonymous with that of killing a human being with malice aforethought. Fortunately for humanity and the generations yet unborn, the virile religions of to-day are rapidly getting away from the belief that the soul alone must be honored while the body should be regarded as the vile source of evils, a dogma that naturally led to flagellations, torturings and maltreatment of the physical body. The early Christian's absolute asceticism which carried its followers far beyond the commendable

and healthful practice of moderation and self-denial, into rigorous austerity and perversion, was not spirituality but fanaticism, not religion but irreligion, destitute of true piety; by its profanation of the great works of Cosmic Creation, it became a positive token of wickedness instead of an indication of goodness. To abstain from needed food and drink and ravage the body by hunger and thirst, to fight the desire for recuperative sleep, to expose the body to the elements or irritate the skin with unnecessarily coarse clothing, to do penance by torturing the body and inflicting harm by either neglect or positive torment, are analogous on the part of the Christians of Old to the Hindu fakirs who swing themselves on hooks, and the Dervishes and Assouans who beat in their skulls with clubs. Such abuse of nature's laws, under the false guise of religion, led to the absolute violation of all laws of sanitation and hygiene, and for many centuries cleanliness was regarded as an indication of corruptness. Many of the most highly venerated of the saints took no care of the physical body and Athanasius relates with approval that St. Anthony, the father of monks, never washed his feet.

With the Renaissance came gradually the appreciation of the human body, and the ideals of the ancient Greeks impressed themselves not only on medieval art, but on science and religion. The pendulum has swung back from the extreme of fanatical error, but there is a tendency for it to swing beyond the point of equilibrium and poise, to another extreme of error under the false designation of "science." No religion can be scientific that ignores Cosmic Laws, and no matter how worthy and true many of the tenets of a so-called religion

may be, there is a great element of danger and positive harm to the world, when any body of enthusiasts, particularly when banded together as a religious sect, and with sufficient truth in their creed to prove many of their beliefs by works, deny the existence, attributes and functions of pathogenic organisms which the microscopist can see and study as we do the larger animal life, and also relegate all "matter" to a plane where it seems fitting to treat it with disdain, if not abhorrence. Matter is real and in some form or other, is as eternal as spirit. Nature's laws control matter, organic and inorganic, as well as every form of life and every substance which we endeavor to classify as animate or inanimate, even where there is extreme difficulty in drawing a line of demarcation between the two. The truly religious scientists should preach the superiority of spirit over matter, of the real man over his physical body, of truth and health over error and disease and of positive mental attributes over the negative characteristics of a vacillating or unanchored mind; but it should go much further and teach man to courageously and fearlessly combat disease, error and evils by prevention and constructive measures.

To understand the laws of hygiene and sanitation is a religious duty, and to keep one's body in health so that it can function as an effective and expressive medium of the soul, is as necessary for the good of the individual, his progeny and human environment, as is conformity with many phases of moral law. Man cannot be scientific in regard to the soul and that which pertains to the spirit, unless he is also scientific in that which relates to any or all of the multitudinous branches of creation and phases

of universal law. Cosmic laws are not changed by human petition. Much healing is done by right thinking and many cures wrought by medicine or religion are a tribute to the power of suggestion through faith. Right thinking augmented by right living—faith with works—is the unfailing rule of health and mankind will be both spiritually and physically benefitted when religion teaches that God is too great to perform miracles. He expresses His love to mankind through the medium of unchanging laws.

It has been said that “scientific knowledge is so indispensable for moral conduct that ignorance must be placed among the most immoral acts.” Metchnikoff has said that a mother who rears her child in defiance of good hygiene, from want of knowledge, is acting immorally toward her offspring, notwithstanding her feeling of sympathy. Parents who deliberately ignore the laws of nature in the bringing up of their offspring, or municipalities and states that violate universal laws in the care and protection of their citizens, are individually and jointly criminal in their wilful neglect of duty and obligation. One must have sympathy for, and strive to educate those who remain in ignorance of the laws of health and well-being, but bitter denunciation should be meted out to those who have knowledge and apathetically refuse to use it, whether their inertia be attributed to indifference, inhumanity or bigoted religious fervor. One of the prime duties of any governing body in these enlightened days—no matter how small or how large and without respect to the number of persons in the community, district or home—is to have knowledge of and con-

form with the universal laws which regulate or affect human life and society.

It has been truly said that if parents are to act morally with regard to their children, they must teach themselves properly. In place of myths and superstition, a mother must learn hygiene and the vital truths which relate to the rational rearing of children; ignorant parents must bring up children badly, notwithstanding all their good will and affection. Metchnikoff says that "A doctor, however imbued with strong sympathy for his patients, could do them much harm if he had not the appropriate knowledge. Are not politicians open to reproach from the moral point of view that very often through ignorance, they do the very worst evil in public administration? With the progress of knowledge, moral conduct and useful conduct will become more and more closely identified." Any habit, act, tendency or thought that tends to prevent or mar the completion of the ideal cycle of human life, is immoral and when we see men and women wasting their health, strength and youth and thus making themselves inefficient for service and incapable of feeling the most complete and lasting pleasures in life, we are compelled to brand them as immoral no matter what their motives for body indifference and abuse may be. The scattering, dispersing and waste of physical powers and human forces are dissipation whether the expenditure be along lines of over-work, neglect of bodily needs, sensuous appetite or intemperance in food or drink.

No man lives to himself entirely isolated from his fellows, and no man can be a moral being unless he considers not only himself, his family, and

progeny but also his neighbors, associates, fellow-beings and mankind in general. To be moral one must conform to duties and obligations which tend toward right living and such behavior as is for the good of all. How then can a man be considered moral and a good citizen who, through indifference or ignorance, contaminates a well or other source of water supply, who through violation of laws of hygiene and sanitation, sells polluted milk, who through transgression of the eternal laws of health and well-being, contracts an infectious or contagious disease and transmits it to his fellows, or who through ignorance, general apathy or perhaps fanaticism of an assumed indifference to matter, inspired by a so-called religion, acts as a carrier of disease to others? Science is the true friend of religion and morality, whereas fanaticism and ignorance are their bitter enemies. Science makes true morality and altruism possible. How can we have a code of ethics or doctrines and rules of moral duties unless we understand the fundamental laws affecting life?

Herbert Spencer insisted that the rules of conduct to be of general application, must not require men to make too great sacrifices. Nevertheless he imagined that in the future the human race will be so improved that moral conduct will become instinctive. Every normal individual has an inborn instinct for the maintenance of life, and egoism or the love and protection of self is a well-known universal human quality—a virtue if not abused and kept in harmony and proper balance with other motives and ideals. To take care of one's health is an act for the good of the individual and is therefore egoistic, but by taking care of one's health

even if selfishly actuated, one guards the health of others and his habits become moral in their operation even if they cannot be considered truly altruistic in spirit.

Ignorance in regard to the laws of nature, of health and well-being is most deplorable and conducive to the baneful effects of error and disease. A degree of knowledge that promotes fear, persistent anxiety with undue mental harassment and solicitude is pernicious and deadly. The natural resistance of the human body to infection by pathogenic micro-organisms is materially lessened by psychological phenomena popularly described as worry or fear. To be subjected to a constant apprehension of evil and to unduly estimate the forces of error and minimize the power of good and normality, are probably more diabolical in their effect upon the human system than the outworkings of ignorance and indifference. Hence the religious belief that denies the existence or potency of an evil, may do untold good to an unbalanced mind obsessed with the horrors of it and which has become unable to relegate error to its proper subordinate place in life. Error and disease are negative; they follow in the wake of goodness and of health and in the eddy of human life, progress, health and well-being. Some people unfortunately seeing one small part or phase of life, obtain an untrue impression of the whole and confuse realism with reality; at times a little knowledge proves to be a dangerous thing to an untrained mind. Virtues are generally positive and vices negative, but there are many qualities or phases of human thought and action that have error on both extremes with virtue in the middle ground. Aristotle taught that each good

quality is a mean between two bad ones, i. e., courage between cowardice and foolhardiness; truthfulness between self-depreciation and boastfulness. It is on this middle ground, the profitable and tenable mean, that we should stand in regard to health and sanitation, declining to be dwarfed by ignorance and indifference, on the one hand, or harassed and swept off our feet by psychological hysteria, fear and fretfulness, on the other. To be truly scientific is to be well-balanced, to give things their proper value, to see that the Cosmic creations and the laws affecting life are good and that conformity to universal law makes for health, efficiency and happiness.

Science teaches defensive as well as constructive measures and there are times when progress depends upon the thoroughness and efficacy of protective means. The Panama Canal could never have been built if we had argued that there was no such disease as Yellow Fever, or if, fully appreciating the horrors of prevalent infections, we had taken no steps suggested by the laws of hygiene and sanitation, to overcome the cause of disease and make the Canal Belt inhabitable. True knowledge does not promote fear, for it furnishes the weapons to combat evil, disease and error. Emerson truly said, "Fear always springs from ignorance." The human mind that is indifferent to enlightenment concerning the phenomena of life is in a comatose and lethargic condition and is wilfully disregarding those psychological powers—the peculiar birth-right of man—which separates the human family from the lower animals. Apparent cognition in regard to one specific thing, phase of life or law of nature, which is accompanied by the ignoring of all

greater universal laws, may excite expectations of evil and constant apprehension of impending danger and thus become indicative, not of knowledge but of ignorance. To be intelligent one must have a firm grasp upon the eternal principles affecting life and while refusing to ignore the baneful effects of error, must positively refuse to be swept from one's anchorage and magnify either the extent of its existence or its destructive power. Ignorance and fear are synonymous but cognizance of error which stimulates sane precautionary and corrective measures, not to mention aggressive constructive means, must not be confused with fear. To forge weapons, dig trenches, fortify and erect outposts, place sentries, ward off attacks and strive to subdue or annihilate an enemy, are not indicative of fear, but to retreat from the foe, to over-estimate his power, throw down arms, surrender without a fight or cowardly and precipitantly flee, suggest *that* fear which in every phase of life is deadly to success and well-being. Montaigne said, "The thing in the world I am most afraid of is fear," and Byron expresses the instability and elusiveness of this negative quality when he wrote:

"Alas, I scarcely now know what it is;  
And yet I fear it, fear I know not what."

Fear is hysterical. It is the foe to mental poise and equanimity. It blackens or reddens the glasses through which we view life, grossly magnifies error and the power of evil, and wantonly minimizes the power and existence of the dominant, positive forces of good and truth.

"Hysteria, fear and worry are the most common forms expressive of the harmful power of error of individual mind con-

trol. There is an old story from the East which well illustrates the destructive power of that form of negative self-suggestion, known as fear:

“‘Where are you going?’ asked the Pilgrim on meeting the plague one day

“‘I am going to Bagdad to kill 5,000 people,’ was the reply.

“A few days later the same Pilgrim met the plague returning.

“‘You told me that you were going to Bagdad to kill 5,000 people,’ said he, ‘but, instead, you killed 50,000.’

“‘No, you are wrong,’ said the plague, ‘I killed 5,000 people as I told you I would; the others died of fright.’

“It has been truly said that we have great power to attract the things we fear and to repel those of which we have no fear, because fear lowers the bodily resistance and courage raises it. It is also true, even though we are loath to admit it, that certain conditions exist, or come to pass, primarily because we courted them by our own expectant attitude.”—The Individual and Society.

The world has advanced greatly in knowledge during the past few centuries, due to freedom of thought, religious liberty, the spread of democracy, the printing press, ease and rapidity of transportation and the transmitting of news and thought. Superstition is gradually being eliminated and religion is glorified, as in its essence it is found to be scientific and not emotional. The Great Plague of the fourteenth century was combated by public church services; sacrifices and even flagellations took place in the hope of appeasing the wrath of the Almighty and thus averting the terrible malady. In the Graben of Vienna stands a large monument erected in the seventeenth century to commemorate the claimed interposition of Providence in staying another of the great epidemics of plague—after it had run its natural course. We now know that we cannot successfully combat any epidemic of disease

by prayer or scourging, for the universe operates by law and is not actuated by the vacillating whims of the Almighty. Science has taught us how to prevent the "Black Death" by conformity to the laws of sanitation and hygiene and whenever it occurs to-day in civilized lands, it is due to the violation of nature's laws and can be quickly confined, overcome and stamped out by conformity to elemental but fundamental laws of sanitation. New York is now in the throes of an epidemic of Infantile Paralysis, a horrible disease, easy to prevent but extremely difficult to control and curb when once it gains headway. At this time of writing the number of cases runs into the thousands and deaths are reported in about twenty-two per cent. of the cases, although the horror of the disease expresses itself most forcibly in the physical condition of the little ones who survive—often to a life of suffering. If ordinary rules for cleanliness had been obeyed, this terrible scourge could never have happened. The steps now being taken to cope with the epidemic are what science and common sense have suggested as maintained routine and are known as laws for the promotion of health and well-being. It is to be deplored that there is a natural tendency "to lock the stable door after the horse is stolen"; it is expressed in the fight to cure and control diseases of many kinds, including the national disgrace—typhoid—instead of preventing them by sane hygienic methods and sanitary conditions which should be demanded and enforced by government in the interest of all its citizens. It is encouraging to find that from many pulpits of our New York churches last Sunday the clergymen, instead of urging prayer and fasting to appease the wrath of God, beseeched

their congregations to practice extreme cleanliness, reading and explaining to them instructions prepared by the Department of Health in harmony with the laws of hygiene and sanitation. Many ministers attacked the proposition scientifically, explaining the cause of disease, the evils which may arise from violation of the universal law of well-being and at the same time cautioned their audiences when being vigilant and careful, not to be unnecessarily alarmed, as fear might lead to a mental condition and erroneous protective practices which would seriously weaken the natural body defences and invite disease. The early Christian and Medieval conceptions that cleanliness and care of the body were opposed to spiritual growth and well-being have been dissipated by science. John Wesley in the eighteenth century originated the saying which has since become famous, "Cleanliness is indeed next to Godliness," and before him Bacon, in "Advancement of Learning," said that cleanliness of body proceeded "from a due reverence to God, to society and to ourselves."

As knowledge of bacterial life has increased, science has been enabled to chart general lines of action which, if religiously followed, will prevent epidemics of disease, and in many cases scientific research has enlightened us in regard to efficient neutralizing methods which, under certain conditions, will successfully cope with noxious micro-organisms and therefore assist humanity in more surely or rapidly overcoming error and curing disease. The normal healthy body is generally well fortified against ordinary harmful bacteria, but if man's actions tend to upset the harmony of environment and ignore the fundamental laws of nature and

health, he automatically increases the potency of forces which seem to be arraigned against him. He relatively lessens his own inherent strength of resistance and will most probably succumb to the ravages of disease and the baneful effects of error or malicious insurgency, unless science can suggest to him an antidote to maintain proper balance amidst the new conditions and overcome the retributive effects of reactive forces which throughout nature always seem to be augmented and rise up in tremendous power with aggressive punitive intent whenever Nature's laws are deliberately or unconsciously violated.

The great work of the scientist and physician is to prevent disease rather than to cure it. Moreover, the human body is so constituted that processes of neutralization, if health is to be maintained, should be performed outside of and not within the human body. If a water supply is contaminated by the waste matter from segregated human habitations and manufacturing establishments, science dictates that such pollution should be overcome by the destruction and elimination of harmful bacteria, before the water is taken into the human system and not afterwards. The body should be protected not only from pathogenic germs, but from all harmful substances, whether taken unconsciously in food and drink or as remedial measures to neutralize and overcome the noxious action of injurious matter and micro-organisms. Medicine and drugs may at times become necessary, but it is always better to have poisons act on poisons outside of the highly sensitive human body. The highest duty of the medical profession should be to prevent disease, to harmonize the individual to his environment and

protect mankind from any evil which may become malignant because of man's violation of nature's laws. If man deliberately abuses his physical body, science may help him to neutralize the bad effects of his error for a time, but medicine cannot save him from the retributive action of merciless forces which operate in harmony with immutable laws; both the error of the original wrongdoing and the effect wrought by believedly curative, palliative or neutralizing medical agents act to maltreat and outrage the human body, lessen efficiency, ignore health and well-being and shorten life. To enjoy good health one should diet in harmony with his mode of life and expenditure of physical effort, live a natural life in so far as artificial civilization will permit, protect himself from the errors resulting from human segregation and man's aggressive subjugation of nature, cultivate knowledge, but abolish all fear of evil and harmful forces and keep from the highly organized and sensitive nervous body all noxious substances, subjecting the physical body just as far as modern life will permit, only to those influences which have been sanctioned by nature and created or the human body's use since time immemorial.

The world abounds today with rabid health fad-dists, diet fanatics, exercise cranks and bigoted advocates of systems, panaceas and cure-alls. There is only one law of health and that is the most unpopular law of Cause and Effect—if one dances one must pay the piper. To obtain or maintain health one must live naturally, avoid the things that are harmful and be moderate in all things. We are inundated today with a perfect deluge of matter regarding health, which masquerades under the false guise of science, but which is as opposed to science

as mythology is to pathology and superstition to religion. A discourse recently submitted to a long-suffering public on the "Philosophy" of Health criticised the pasteurization of milk and ridiculed the germ theory, but most inconsistently advocated the boiling of all drinking water. There are schools of "higher thought" which preach the unreality of matter and yet worship it *in fact* by the practice of Epicurism and the love of wealth. A noted vilifier of the medical profession has written much against the Modern School of Physicians. Not content to attack self-evident errors, he maintains that their entire practice is founded on error, and after denouncing the use of medicine at all times, and after obtaining a large enthusiastic following, he later, with the object of increasing his own income, is constrained to sell at a high price a panacea of supposedly wonderful power, which he claims is *not* medicine, although it looks like it, is used as medicine and apparently acts like it. Perhaps this advocate of rational healing has found by experience that the full power of suggestion can seldom be obtained unless the patient has some definite act to perform or some tablet to take.

The medical profession is a most worthy one and the world owes much to the honorable followers of a calling whose prime duty in life is to strive to heal the sick, ameliorate human suffering and overcome disease. There are good and bad doctors in the world just as there are good and bad lawyers, engineers and mechanics. The often supposedly talismanic letters M. D. are not a badge of learning, morals or honor, but the medical profession, with all its shortcomings, faddism and, at times, advocacy of error, compares favorably with any other profession,

even including the ministry. The medical profession, by the sure-working law of progress and evolution, is destined to be a great power for good in the world, for it will be organized before long to prevent disease, to create hygienic and sanitary conditions wherever man dwells, and its great work in the world will be to teach men, women and children the true science of the universe—the laws of health and how to live efficiently, sanely and happily. The advance in the art of surgery has proven a great boon to humanity, and skilled surgeons today are performing anatomical operations and correcting errors in the human mechanism caused by violent accidents or erroneous living; they are saving lives and overcoming defects which would be beyond hope of curing by corrective and natural methods. Whereas the knife should never be used except as a last resort, there are many occasions when the surgeon stands between a life pregnant with capabilities of useful service and—as far as the world and our present existence is concerned—oblivion. Whereas within the pages of this book there may appear at times criticism of the medical profession, it must be understood that the author has in mind those of the profession who have been and are abusing the dignity of their calling. At no time has he lost sight of the splendid, self-sacrificing, scientific and noble men in the profession or of their laudable ideals. Science and humanity will ultimately combine to make the profession of the physician one of the noblest, if not the noblest, of all callings, for, as the name implies, it should teach men to live according to the laws of nature.

The scientist and competent physician suffer much from the ignorance of the laity in life, and no

ignorance—not even that of quackery and charlatanry—is as deadly to progress and well-being as that of a self-satisfied, bigoted advocate of a health system, whether it be organized as a religion or merely as an unscientific commercialized belief. It is said that a New England woman had a shallow surface well of water near her home, in close proximity to an old-fashioned outdoor domestic privy. A resident physician, being convinced that the water of the well was contaminated by human excreta, urged the closing up of the well and was promptly met with indignant antagonism. After many futile attempts to convince the owner of the property that the polluted water of the well was a menace to the health and well-being of the community, the physician poured mineral oil into the privy and was later sued by the wrathful owner for ruining the well and defiling her water supply. As long as the water tasted all right the woman was convinced of its purity, refusing to believe that sewage in water does not taste badly, but when the doctor proved his theory of pollution with a comparatively harmless oil, which could be promptly detected by the human palate, the owner of the well forgot the doctrines of the unreality of matter and the superiority of the soul and vigorously demanded redress in the courts for a meritorious act of education which should have carried conviction to the mind of any normal unbiased person, whether intelligent or ignorant.

The laws of nature are permanent and unalterable, and if one is to enjoy health, he must live in harmony with the great natural laws. Nature and religion are not opposed terms, for as Young said, "The course of nature is the art of God." There

is no short-cut to health, no sect or talismanic belief that can hurdle barriers raised by one's deliberate or nescient violation of physical laws. Pope said that a real man is he who is

“Slave of no sect, who takes no private road,  
But looks through nature, up to nature's God.”

And Thomson said that man enriched with the knowledge of nature's works is lifted to heaven.

To be truly religious or positively efficient in life, man must be in harmony with eternal truth and therefore must be scientific. He will strive to possess knowledge of ultimate principles and causes and learn the operation of general laws. To be healthy and sound in mind, body and soul, man must conform with those universal laws which make for harmony with nature and Cosmic forces. These eternal principles are substantially and fittingly expressed by sane, right living; they promote that psychological and physical condition known as happiness, make for the enjoyment of health in all its fullness and thus fortify man to perform his work in the world acceptably and efficiently.

Short Hills,  
New Jersey,  
August 1, 1916.

W. A. F.

# I.

## WATER

**T**HE most important natural agencies for the preservation of health are pure water, pure air, sunlight, exercise and proper diet. The first three are furnished by Mother Nature "without money and without price," the fourth simply requires a slight exertion of the will power, and the last is obtainable by any man who is willing to put to use his capabilities and exercise will power, tempered with intelligence. Water is the original source of all animal life; from it the earliest species were evolved and it continues to be the principal constituent of our bodies, one of the most important factors in sustaining existence, and the largest item in the income of the human body. Water is the only substance known that possesses the power of permeating every cell and fibre of the living organism without causing disturbance or irritation. It is an essential part of all the tissues and its percentage in their make-up cannot be materially reduced while life continues.

Water is the principal agent in the elimination of waste material and poisons from the body; it is the flushing medium and the carrier, accelerator or vehicle of excretion used by what may be termed the human sewage system. Water acts to dilute the food so that the nutrient content can be absorbed from the digestive tract; its presence in the blood is essential both to carry food to the tissues and to

carry the waste matter away from the tissues; it is also needed to keep the blood pressure and the heart in a normal condition. When water evaporates from the body, it often provides for the removal of heat which would otherwise accumulate in the body to its detriment. When the discharge of water is abnormal the feeling of thirst is aroused and suggests a prompt renewal of the stored supply necessary for a state of healthful equilibrium. The bodily organs demand water and if they do not receive it of proper purity and in required quantity, they do their work poorly, waste products accumulate and putrefy, the blood becomes vitiated, the breath foul and disease germs find a fertile soil.

### **Water in Relation to the Human System**

Sohn says that the human body consists of from 55 to 71 per cent. of water by weight. Rubner gives the percentage as 63 and other authorities have mentioned from 60 to 75.3 per cent. The fluids of the body are all extremely aqueous and the tissues so thoroughly permeated by liquid that they may be said to be bathed in water. The percentage of water in body fluids and tissues, etc., is generally as follows:

Gastric Juices		99.5	per cent.
Saliva		99.5	" "
Perspiration	98 to 99	"	"
Aqueous humor of eye	98	"	"
Blood plasma	90	"	"
Muscles	70 to 75	"	"
Brain and nerves	64 to 84	"	"
Bones	10 to 30	"	"

Aside from the fluid drunk, of which the average healthy man takes about  $3\frac{1}{2}$  pints, or  $3\frac{1}{2}$  to 4 lbs.

daily, a considerable amount of water is taken unconsciously with food, for water exists in almost all of our various articles of food as the following table will show.

	per cent. water		per cent. water
Sirloin steak	61.9	Wheat flour	13.8
Ribs of beef	57.0	White bread	35.0
Breast of veal	68.2	Brown bread	43.6
Leg of lamb	58.6	Apple pie	42.5
Pork tenderloin	66.5	Asparagus	94.0
Smoked ham	39.8	String beans	83.0
Smoked bacon	20.2	Cabbage	91.5
Chicken broiler	69.7	Celery	94.5
Blue fish	78.5	Cucumbers	95.4
Cod	82.6	Lettuce	94.7
Oysters	86.9	Potatoes	78.3
Eggs	73.7	Apples—edible—	84.6
Butter	11.0	Bananas “	75.3
Pale American Cheese	31.6	Grapes “	58.0
Milk	87.0	Oranges “	86.9
Cream	74.0	Lemons “	89.3

Coles-Finch has said that if we wish to keep in health, we must consume about  $1/25$  of our own weight of water—all told—per day. Other authorities state that a healthy adult requires from  $4\frac{1}{2}$  to 7 lbs. of water daily for the process of nutrition with proper aqueous equilibrium and about 35 per cent. of this amount is usually contained in foods, the remainder being taken in the form of liquids. In addition to the water that we drink and take with our food, without being aware of it, a certain quantity of water is formed within us by combustion in the process of digestion. Water is the natural beverage for the maintenance of life and health and is one of the prime necessities of life. Man can

subsist for much longer periods of time without food than without water. Fresh wholesome water is a fine tonic, a carrier and body builder; it is one of the best natural solvents and when taken in proper quantity and at the proper time, tends to wash impurities out of the body.

“Till taught by pain,  
Men really know not what good water’s worth.”

Byron.

### **The Human Body Like a Steam Boiler**

Water as fed to the body may be considered analogous to feed water delivered to a steam boiler. Steam is gaseous water; blood plasma which flows through the circulatory pipes of the human body is 90.15 per cent. water. Boiler feed water must be relatively pure and free from deleterious matter or the boiler structure soon deteriorates, corrodes and wears away. Drinking water fed to the human system must be comparatively pure, fresh and wholesome, if the bodily health is to be maintained; but as steam and power cannot be generated in a boiler without water, neither can the human machine perform its functions, create power or exist without water. Feed water is usually heated before it is fed into a boiler. No engineer would cool or ice his feed water before delivering it to the boiler because of the danger to the structure and positive thermal inefficiency. Tepid water is not palatable, but natural, cool spring or deep well water is. Why ice nature’s cool water and why feed ice water to the human body when one would never think of doing such a pernicious thing to a boiler made by human hands? Very cold water swallowed rapidly chills the mucous membrane of the stomach and re-

tards the progress of gastric secretion. Digestion itself is also slowed if the contents of the stomach are cooled, just as steam cannot be raised as quickly with cold feed water as with warm feed water. Hot water under certain conditions is healthful and medicinal. Jaworski has shown that, as a rule, hot water disappears from the stomach much more rapidly than cold water. In some persons, however, much harm may be done by the use of excessively hot drinks, as well as by the use of iced drinks. Boas states that many stomach troubles are caused by the habitual use of either very hot or very cold drinks.

Wholesome water with its natural coolness is healthful and palatable, but the use of artificially cooled ice-water, now quite common, is an injurious habit and is opposed to the laws of nature and health.

### **The Law of Right Drinking**

To "drink right" is a most important law of physical well-being. Sheldon has divided the law into five phases:

First,	What to drink,
Second,	When to drink,
Third,	How much to drink,
Fourth,	How to drink,
Fifth,	What not to drink.

The fifth is the negative of the first, but needs to be emphasized and was apparently added to permit forceful, definite exceptions, and also because of the psychological power of specific admonition. If a person lived a normal, natural life, natural hunger would suggest the time to eat and natural thirst the

time to drink, but very few of us live a natural life. Bad drinking habits generally go hand in glove with bad eating habits and one merely serves to intensify the error of the other. A few fundamental and elemental facts in regard to drinking should be kept in mind.

1. Water or any other liquid was never intended to flush food from the mouth into the stomach. The saliva of the mouth should be given an opportunity to commence the process of digestion and lubricate the food for passage into the stomach.

2. Water or any other liquid is opposing nature if it is used to soften food and prepare it for quick entrance to the stomach, thus preventing the operation of nature's process of mastication.

3. Free water drinking is not good for every one. Intelligent water drinking *is* good for all. The extent of healthful water drinking depends absolutely upon the individual—there are no universal laws for there is no uniform standard of health, physical similarity or conformity to a mode of life. Excess of water should be avoided by the very feeble, those suffering from weak kidneys, heart trouble or dropsy. Free water drinking for a healthy person is good when the stomach is empty and particularly on arising in the morning, but free water drinking for any person at meals is detrimental to health and for many people much water at meals is constipating, although much water between meals or on an empty stomach has an opposite tendency. A moderate amount of cool fresh water—not iced—at meals is not injurious to health and is often beneficial, if the water is taken when the mouth is absolutely empty of food.

4. A person in average health in an average

climate and engaged in moderate work should drink  $1\frac{1}{2}$  to 2 quarts of water daily, but the amount depends upon a man's work and the environment in which he is placed. A man engaged in a sedentary occupation, in a moist temperate climate, does not need half the water that a man requires working hard outdoors in an atmosphere of high temperature and sunshine. A good rule for the average person is to take one or two glasses of pure water upon arising, one glass or more after two-thirds of the time between breakfast and the mid-day meal has elapsed; one glass or more after two-thirds of the time between the mid-day and evening meal has elapsed and a glass immediately before retiring, drinking with positive moderation at all meals.

5. Drink only fresh water that you know to be wholesome and healthful. If in doubt boil your drinking water which will kill any bacteria or germs present and then shake it up, liven and aerate it as much as is feasible to make it palatable. An authority on preventable diseases has said that 85 per cent. of the cases of typhoid fever in the country are due to drinking impure water. It is reported that 300,000 people each year, through drinking impure water, enlist under the typhoid banner. Fisher and Fisk say "where hygienic water has been used, a very large proportion of the deaths from typhoid has been eliminated. Where this is not feasible it is desirable to use chlorinated lime (ordinary bleaching powder) in drinking water (one part to 200,000—shake up and leave several minutes). If water of doubtful quality has to be drunk, it should be at the middle or end of a meal when the healthy stomach contains plenty of gastric juice which, to a limited extent, has the power to kill germs." Impure water

as well as ice-cold water causes stomach and bowel troubles.

6. Water, whether cold or cool, should not be rapidly gulped down, but should be taken slowly and with rational deliberateness. Many of the illnesses and prostrations prevalent in hot weather are the result of rapidly drinking and gulping down great quantities of very cold water. Sheldon advises drinking water with accompanied auto-suggestion and he presents this thought—"This water is one of the life essentials. It clears my system and carries away waste products. It increases the secretions. I am drinking the right drink and thinking the right thoughts. I feel good, bright, cheerful and happy."

7. Water is nature's drink. Spring and deep well waters, unless polluted by man and his works, are almost invariably pure and healthful, for the earth is a filter and cleanses the water of any impurities which it may hold as it seeps downward through the soil. Brook water or any thin film of surface water in motion is purified by the actinic rays of sunlight. River water is generally pure and healthful unless contaminated by man with sewage, manufacturing waste, etc.

#### **Water the Basis of all Beverages**

Purinton says, "Water is the best tonic known and the saloons persist largely because they sell barrels of water in the guise of something else. While the habit of 'treating' is absurd and often harmful, it is based on a generous impulse and fundamental need—that of supplying water in a palatable, attractive form." Purinton further says that "in modern civilization, real water costs real

money. Bottled water is bottled health." Real water is as free as real air and both are easy to obtain by intelligent effort. Some bottled waters are excellent, pure and invigorating, but there are some instances on record where bottled waters have been bottled disease. If water is pure and good, bottling it adds to its natural radius of use and benefit. If water is bad, bottling it increases its power for ill, and if bad water is bottled and labelled good, the evil is intensified beyond human estimate or knowledge. Purinton advocates sarsaparilla, celery tonic or ginger ale—which, he adds "are wholesome varieties of doctored water." Dr. Tolman is nearer the truth when he says that "most of the cheap ginger ale, sarsaparilla and such beverages contain too much sugar and in addition are adulterated and positively harmful."

### **"Soft Drink" Impurities**

It is a question whether Soda Fountains or Beer Gardens are the more harmful in a community. The Soda Fountain generally abounds with artificial coloring matter, fake fruit juices, drugged drinks and water charged with gas. The principle of its service to the public, no matter how honorable and ethical its promoters and owners may be, can by no stretch of the imagination be considered hygienic or conducive to health. Soft drinks have as a base, soda water, which contains no soda but carbon dioxide, and the general objectionable features of these drinks are saccharin, a coal-tar drug product, saponin, a "heading" ingredient which is a poison that tends to destroy the red corpuscles of the blood, multitudes of adulterants, some quite noxious, stimulating or narcotical drugs

and poisons and the possibilities that such drinks contain bacteria due to lack of sanitary and hygienic conditions surrounding manufacture, bottling or handling. The factory-made lemonade is usually carbonic acid water, cheap syrup, tartaric acid and oil of lemon. Ginger beer is generally similar with the addition of a little essence of ginger, or cheap substitute for it. Orange juice as served over the counter, and even in many hotels and trains, is almost entirely artificial and the gases of orange peel and lemon peel are often the base of these fruit juices; the injurious action of such matter in the human stomach has kept many a man from benefiting from real fresh fruit juices with their invigorating tonic effect when properly used. Many soft drinks are positively injurious, some are "habit-forming" and many so-called food drinks encourage one to dietetic foolishness. Doctored waters, home-made or the product of hygienic factories, operating with so-called "pure food" formulæ, may please the palate, feed water to the system and be generally harmless, but nature is always doctored to the detriment of him who uses the concoction. Man cannot improve on nature but he can, of course, so abuse his sense of taste that nature's product becomes displeasing and distasteful to him; this is but one of many instances indicative of the degeneration of man through an artificialness which we proudly call "civilization." Doctored waters or drugged drinks *may* be used at times in moderation and pathologically to advantage, but nature is the true medicine of life and if the body functions in harmony with nature, no medicine of any kind other than wholesome water, pure air, sunlight, exercise and proper adaptable food will be needed.

**Water Necessary for Bodily Functions**

We can very materially vary our practice of water-drinking without experiencing pronounced effects, and as water is known to be a cleanser and carrier, the common modern teaching is to the effect that one can hardly drink too much water, unless it be at meal times. The beneficial results supposed to accrue from free water drinking are assumed to include the avoidance of constipation and the elimination of dissolved waste by the kidneys and possibly by the liver. Water is practically unabsorbed by the stomach and in a normal healthy person it quickly passes into the intestines,  $\frac{1}{2}$  to 1 pint of water leaving the average stomach in about half an hour. Water fed to the body imbibes salt from the food, mucus or from the superficial cells of the alimentary tract or takes up the salt which is formed in the upper chamber of the intestines by the neutralization of the hydrochloric acid of the gastric juice. Hence water becomes a salt solution and instead of passing on through the intestines to the rectum, is absorbed. When water is ingested therefore, it does not normally pass out with the feces; and under ordinary conditions of absorption, no matter how much is drunk, it does not of itself produce a movement of the bowels but leads to increased urination. It is quite possible, however, that bowel functions are assisted by the use of water, for if the contents of the upper intestines are well supplied with liquid, the forward movement of the feces must of necessity be greatly facilitated. Water is diuretic and its elimination tends to carry from the body certain dissolved substances, especially urea, sulphates and phosphates. Hill maintains that water washes out the urea stored in the

tissues and does not provoke increased destruction of tissue protein, whereas, Hawk asserts that copious water drinking results not only in a removal of stored-up urea but also in increased protein destruction.

Excessive water drinking is generally and most rightly considered injurious to persons with weak kidneys, but it is quite possible that at times the duties of the kidneys may be lightened by giving them more water to excrete. It is quite right to judge the work of a gland by the volume of its output, but concentration is an all important factor which puts the tubules of the kidneys to the severest test, and these delicate organs act at the greatest disadvantage when required to excrete a maximum of solids in a minimum of water. Stiles says, "The urine almost always has a concentration much higher than that of the blood from which it is derived and it is fair to assume that the separation of the two fluids would be much easier if the difference of concentration could be lessened. Water drinking is the natural way to secure this result."

#### **Effect of Too Much Water**

The continued use of large quantities of drinking water, in excess of the body requirements, would soon tend to impair the functions of the various organs by materially increasing the volume of blood in circulation, thus overloading the heart and embarrassing its action, lessening the activity of the digestive juices and causing indigestion which is often the first factor of a series of errors which may ultimately lead to pronounced faulty metabolism and mal-nutrition.

The rule for water drinking is practically the same as eating and can be expressed as—sufficient,

but not too much. In eating, however, the average person has a tendency to err by excess; in drinking there is a pronounced disposition and apparently inherent proneness to err the other way. The advocates of free water drinking are striving to overcome the natural tendency of the average person to rob the body of nature's liquid necessary for health. The tremendous consumption of coffee, tea and cocoa, containing injurious drugs, has a somewhat compensating side, when we consider that water is the principal constituent and that in the majority of cases the water has been made sterile by boiling. The same general thought applies to many other honestly-made soft and mild alcoholic drinks, for they apparently lead people to take much more water than they would otherwise and many of these waters have been sterilized in the manufacture of the beverage.

### **Proper Water Balance**

Like the plant, man cannot live without water. Lorand has said, "A plant may have at its disposal ever so much of the nutritive salts without which it cannot live, but they are of no use to it unless it receives water, be this rain-water or dew or that provided by the helping hand of man; water is absolutely required to bring these salts into solution so that they may be absorbed by the roots. Man, likewise would not be able to assimilate his food without water since it dissolves the nutritive substances that they may be taken up by his body." Water is the blood-carrier of the dissolved nutritive substances and salts which feed the body tissues. For health and necessary "water balance" the blood should not become too thickened or too dilute. The excessive

intake of liquids tends toward blood dilution; the persistent or excessive use of laxatives and cathartics and abnormal physical conditions, such as copious diarrhoea, also an insufficient consumption of liquid, cause blood inspissation which fortunately can be quickly overcome if the body is supplied with normal quantities of water. Persons with a weak heart and hardened blood vessels (arteriosclerosis) or diseased kidneys should guard against the sudden overloading of the system with liquid, and in severe acute cases, it may be advisable to feed the system with its required water in the form of fruit, green vegetables and small sips of water, in order that the water may be absorbed gradually without undue taxation of the weakened vessels and organs. The opinion is commonly held that free water drinking favors increase of bodily weight. To a limited extent such increase of weight may result from actual retention of water, but as has been clearly demonstrated by Von Noorden, water-drinking of itself never causes the production of fat. Stout people have a tendency, however, to drink a great deal of liquid, but this is in part a consequence rather than a cause of their condition. As Stiles has pointed out "subcutaneous fat is a hindrance to the escape of heat from the body and its presence during warm weather necessitates an unusual amount of perspiration. This in turn produces thirst."

### **Water With Meals**

Liquids should not be debarred from meals. A little hot soup (85 to 97 per cent. of water content, according to U. S. Government investigations) at the commencement of a meal is a healthful, invigorating and stimulating "cocktail" for a normal

person. Abstinence from direct water intake with solid food favors digestion and the normal action of the digestive juices which commences with the important flow of saliva in the mouth. Such a practice naturally causes slower eating and slower eating tends toward health and the satisfaction of the appetite with a smaller actual intake. Gormandizing will not exist if liquids are debarred from the mouth while food is being masticated and is in passage to the stomach. Gastric juices within the stomach are not materially affected by water; they are naturally diluted but act on a larger volume of the mixture. Hawk, of the University of Illinois, has shown that the proper drinking of water with meals is conducive to health and efficient digestion. He has shown that the fecal nitrogen is lower when water is taken in good quantity as compared with liquid abstinence. This fact, he holds, indicates more complete digestion and more thorough absorption.

### **Hot Water as a Therapeutic Agent**

Hot water has been termed the "natural scavenger," and Tyrrell says, "As a therapeutic agent it is almost without a peer. Chemists are burning the midnight oil in their laboratories searching for new weapons with which to fight sepsis, while hot boiled water which is one of the best antiseptics in existence is almost ignored." Hot water used occasionally and when needed as a stomach bath or an intestinal bath, will perform beneficial functions harmlessly in overcoming the effects of unnatural living that no medicine can ever accomplish with its poisoning and deleterious after effects. The use of a proper diet and a sufficient quantity of

wholesome water taken at the proper time, will prevent stomach trouble and constipation, but if these disorders occur through ignorance or deliberate violation of nature's laws for the body, it is far better to use hot water as an internal bath and wash away putrid matter, rather than resort to the use of drugs which do their work only in part and that unnaturally. Drugs can never cure constipation, but intelligent diet and the proper use of wholesome drinking-water will. At times the use of water containing a large proportion of lime salts may tend to produce costiveness, but this can be overcome by a diet containing fruit, coarse bread, green and watery vegetables with little starch and much fibre, or by the boiling of the water thus robbing it of its temporary hardness. Bowers has said that constipation is caused by too much of the wrong kind of food; lack of proper nerve and muscle tone and "not enough soft water or an excess of the other kind" (hard water). The use of enemas or preferably internal hot water baths with sterilized water, is far better than any form of drugs taken into the stomach which performs its work by poisoning the system and robbing the blood of much water. Constipation is a serious ailment and should not be lightly treated, but the cure lies in sane eating, drinking and living; the too frequent use of enemas and internal water baths may tend to lower the muscle tone of the main colon. Water injected into the rectum should be sterilized, for noxious pathogenic bacilli may in this manner be permitted to enter the system without passing through the protective stomach acids which tend to weaken or make the majority of bacteria taken with food and water innocuous. Water is not only one

of the prime necessities of life, but unfortunately in its relation to preventable disease, it may be ranked next, if not indeed equal, to air in importance. Too much care cannot, therefore, be exercised in the selection, preparation and use of water for drinking purposes or for internal baths.

### Water and the Elements in Ancient Lore

Certain ancient philosophers maintained that one of the only four elements known in their day (i. e., fire, air, earth and water) was the origin of all things. Thus Thales held that *water*, Anaximander *air* and Heraclitus *fire* was the original principal. The four elements of the ancients were not considered as single substances, as is generally supposed, but merely modifications and important prime compounds of one great unformed principal, the first matter, from which they conceived that all bodies in the universe were and are constructed. That form with which fluidity is associated, was called water and under this term was comprehended not only the native element, but every other modification of matter which assumes a similar form, such as "the juices of vegetables and the fluids of animals." Another arrangement of created substances called "earth" was that under which they ranged all metals, stones and the like. "Air" covered all matter in an aerial, vaporous and gaseous state, and by "fire" was meant matter in its extreme state of tenuity and refinement. It was believed that fire was diffused through the universe, being sometimes in a "sensible" and sometimes in a "latent" state, or as Aristotle expressed it, heat exists sometimes in capacity and sometimes in energy.

Some of the earliest speculators in philosophy contended that all the materials which compose the universe existed at one time in a watery or fluid form and Adams says "it is curious to reflect that modern geology has reproduced nearly the same doctrine." Fire was the element with which many ancient philosophers supposed life to be most intimately connected, and some of them went so far as to consider fire as the very essence of the soul. "I am of the opinion," says the author of one of the Hippocratic treatises, "that what we call heat is immortal." Aristotle, the past master of logic and philosophy, commenting on the views of his day, fittingly said, "Some improperly call fire, or some such power, the soul; but it would be better to say that the soul subsists in such a body because heat is, of all bodies, the one most obedient," and the soul "performs by the instrumentality of this quality"—uniform bodily heat is essential for the continuance of human life. Speaking of the development and reproductivity of man, Aristotle says "This belongs to the soul rather than to fire, to the reason (spirituality) rather than to matter."

The ancient philosophers taught the transmutability of the elements into one another and did not hesitate to proclaim as a great general truth "that all things are convertible into all things." The ancients noticed the changes that water undergoes in the process of vegetation—how it is converted into various woods, bark, leaves, flowers or fruit, all of which are resolvable, by the process of decomposition, into air or reducible into earth; we now know that all the solid parts of a tree may undergo a mutation into rock. But it is in the higher classes of animals that these changes of

simple matter admit of the greatest variety. Writing of the works of Hippocrates, Adams says, "let us contemplate for a moment some of the most remarkable mutations which any article of food (as for example, bread) which has been presented to the stomach, is destined to undergo in the animal frame. We know that the vital powers of the stomach will convert the starch, of which it principally consists, into a fluid state which is called chyme and afterwards, when it has undergone some further changes, becomes the chyle of the physiologists. It is then changed into the liquid blood and so complete is the transformation that scarcely one particle of the original food can be detected in the new product by all the vaunted skill of modern science. Blood is afterwards converted into many other fluids and solid substances, such as bones, cartilages, muscles and vessels and into bile, mucus and other recementitious matter, all greatly differing from one another both in appearance and properties."

Sir Isaac Newton said that nature seems to delight in permutation and he particularly expressed the views of the ancients and practically duplicated the words of Strabo (63 B.C.) when he said "water which is a very fluid, tasteless salt, changes by heat into vapor, a sort of air; and by cold into ice, which is a hard, pellucid, brittle, fusible stone and this stone returns into water by heat, and vapor returns into water by cold. Earth by heat becomes fire and by cold returns to earth."

Heraclitus said that "the dissolution of earth is to become water and the dissolution of water is to become earth, and the dissolution of air to become fire and conversely."

Hippocrates, born 460 B. C. and venerated for over 23 centuries as "The Father of Medicine," wrote that the bodies of men and animals are nourished by three kinds of aliments, viz.: food, drink and air. After discussing atmospherical moisture, vapor and humidity he says, "And I wish to give an account of the other kind of water, namely: of such as are wholesome and such as are unwholesome and what bad and what good effects may be derived from water; for water contributes much toward health. Such waters then as are marshy, stagnant and belong to lakes are necessarily hot in summer, thick and have a strong smell since they have no current; but being constantly supplied by rain-water and the sun heating them, they necessarily want their proper color and are unwholesome; in winter they become congested, cold and muddy with the snow and ice. Such waters then I reckon bad for every purpose. The next to them in badness are those which have their fountains in rocks so that they must necessarily be hard or come from a soil which produces thermal waters, such as those having minerals and salts in them; for all these are formed by the force of heat. Good waters cannot proceed from such a soil, but those that are hard and of a heating nature, difficult to pass by urine and of difficult evacuation by the bowels. The best are those which flow from elevated grounds and hills of earth; these are sweet, clear and can bear a little wine. But those are most to be recommended which run to the rising of the sun and especially to the summer sun, for such are necessarily more clear, fragrant and light. But all such as are selfish, crude and hard, are not generally

good for drink, but there are certain constitutions and diseases with which such waters agree.”

“Rain waters are the lightest, sweetest, thinnest and clearest; for originally the sun raises and attracts the thinnest and lightest part of the waters, as is obvious from the nature of salts; for the saltish part is left behind owing to its weight, and forms salts; but the sun attracts the thinnest part and subtracts this not only from the lakes, but also from the sea and from all things which contain humidity, and there is humidity in everything; and from man himself, the sun draws off the thinnest and lightest part of the juices (perspiration). Wherefore, of all kinds of waters these spoil the soonest; and rain water has a bad smell, because its particles are collected and mixed together from most objects so as to spoil the soonest. And in addition to this, when attracted and raised up, being carried about and mixed with the air, whatever part of it is turbid and darkish is separated and removed from the other and becomes cloud and mist, but the most attenuated and lightest part is left and becomes sweet, being heated and concocted by the sun, for all other things, when concocted, become sweet. While dissipated thus and not in a state of consistence it is carried aloft. But when collected and condensed by contrary winds, it falls down wherever it happens to be most condensed. Such water requires to be boiled and strained. Waters from snow and ice are bad, for when once congealed, they never again recover their former nature; wherefore, I hold that water from snow and ice or those allied to them are the worst of any for all purposes whatever. Men are seized with disease when they drink water from great rivers into which

other rivulets run or from a lake into which many streams of all sorts flow, for it is impossible that such waters can resemble one another, for one kind is sweet, another saltish and aluminous and some flow from thermal springs, and these being all mixed up together, disagree and the strongest part always prevails; but the same kind is not always the strongest, but sometimes one and sometimes another. There must be deposits of mud and sand in such water and disease must be engendered by them when drunk (by some people), but not to all."

Hippocrates, in his treatise on the use of liquids, also gives advice in the use of cold and hot water internally and externally in the treatment of disease, of which a modern critic says, "That they are highly important and evince an extraordinary science for apprehending the true bearing of practical points in healing, will hardly be denied by any person who is a competent judge."

Strabo wrote nearly twenty centuries ago, "There are varieties of the watery element, for this kind is saltish and that sweet and fit to drink, and others again are poisonous, salutary, deadly, cold and hot." Plato (427-347 B. C.) in the *Timaeus* Dialogue says, that "water is called liquid because of its motion and the way in which it rolls upon the earth; and soft because its bases give way and are less stable than those of earth. When congealed above the earth, water becomes hail, and when on the earth, ice; when compressed to a less degree and only half solid, when above the earth it is called snow and when upon the earth and made from dew it is called hoar-frost. Then, again, there are the numerous kinds of water which have been mingled with one another, and are distilled through plants which

grow in the earth; this class is called by the general name of juices or saps. The unequal admixture of these fluids creates a variety of species: most of them are nameless, but four, which are of a fiery nature, are clearly distinguished and have names. First, there is wine, which warms the soul as well as the body; secondly, there is the oily nature, which is smooth, is bright, shining and of a glistening appearance, including pitch and the juice of berries; also, thirdly, there is the diffusive class, which produce sweetness, and these are included under the general name of honey; lastly, there is opium (?) which differs from all other juices and is a frothy liquid having a burning quality which dissolves the flesh."

The wisdom of the ancients is not generally appreciated in our fevered research and speculation regarding the mysteries of the universe and the development of science. We now know that water is a compound and not an element. We read that the ancients believed that there were only four elements, water, fire, earth and air, and later the Alchemists maintained that there were only three chemical elements, salt, sulphur and mercury, or the soluble, the combustible and the metallic. To-day we affirm that there are 82 elements known to modern science, an element being an ultimate undecomposable constituent of matter. The number of elements has been constantly increasing during the last century of our "Mad rush of progress," but our knowledge of today is still steeped in much ignorance. Notwithstanding our research and scientific triumphs, we have advanced but little beyond the attainment of the philosophers of twenty-four centuries ago. Democrites, discussing the four

elements as classified in his day, stated that each of the elements, water, fire, earth and air, were formed of atoms "infinite in magnitude and number."

In mentioning the opinion of the ancient philosophers, it is not necessary at this time to analytically probe into their theories, hypotheses and deductions, for it seems sufficient for our purposes to obtain a general comprehensive impression of their views. There is but little that we know today about such substances as water, that was not known or appreciated in an embryonic fashion by the sages two or more millenniums ago. Greater and more co-operative facilities and opportunities for research, the perfection of mechanical apparatus, the printing press, railroads, steamships and the practical utilization of electricity, have given us opportunities during the comparatively recent past, of checking up and continuing the cruder investigations of the mentally brilliant philosophers of old; and modern science with all its triumphs has to admit that, in the majority of cases, the premises of the ancient sages were sound in principle. The modern views of Scientists and Sanitary Expert Engineers, which we will briefly describe in our practical treatise on water for use in the human body, we find had their prototypes in the teachings of the ancient seekers after truth.

### **Chemical Analysis of Water**

Water is the oxide of hydrogen and consists by weight of 88.9 parts of oxygen united with 11.1 parts of hydrogen, or by volume of two parts of hydrogen combined with one part of oxygen ( $\text{H}_2 \text{O}$ ). If frozen into solid ice, water retains its chemical constitution, although altered in physical

form. If converted by heat into steam, it is evaporated into invisible vapor. All these forms, liquid, solid and gaseous, are dependent upon temperature only for their maintenance.

Water at 60° F. weighs approximately 1,000 ounces avoirdupois (62½ lbs.). This is taken as a standard to which the specific gravity of all liquids and solids is referred. The relative weight or the specific gravity of various waters and other substances is as follows:

Average rain water	1.000
Distilled water 39° F.	.998
“ “ 60° F.	.999
“ “ 212° F.	.957
Average sea water	1.026
Mediterranean Ocean	1.029
Dead Sea	1.240
Ice at 32° F.	.920
Atmospheric Air	.0012
Mean density of the earth	5.66

The change of volume and density of fresh water with varying temperatures is given in the following table:

Temperature	State	Specific Volume	Density
32° F.	Ice	1.08999	0.91752
32° “	Water	1.00012	0.99988
35.6° “	“	1.00003	0.99997
39.2° “	“	1.00000	1.00000
42.8° “	“	1.00003	0.99999
46.4° “	“	1.00012	0.99988
50. ° “	“	1.00026	0.99974
68. ° “	“	1.00173	0.99827
86. ° “	“	1.00425	0.99577
122. ° “	“	1.01197	0.98817
212. ° “	“	1.04323	0.95856

## DENSITY CURVE OF WATER

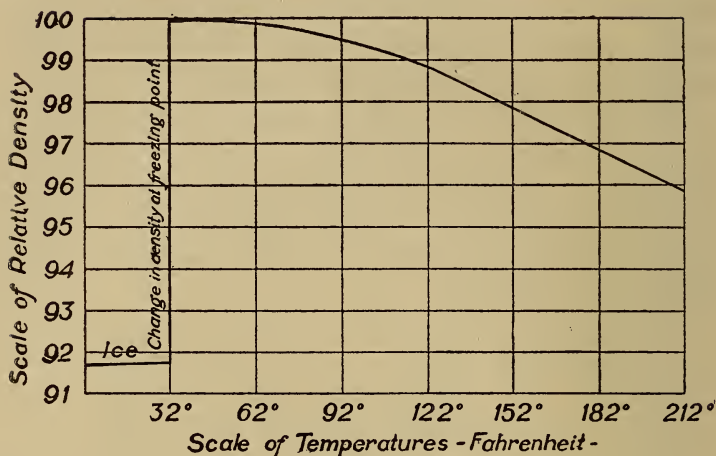


FIG. 1.

The vapor pressure of water is 4.58 m.m. at freezing point and increases rapidly at higher temperatures, being 760 m.m. at the boiling point. The weight of fresh water per standard volume likewise varies with temperature.

Temperature	Weight per Cubic Foot
32° F.	62.417 lbs.
35.6° F.	62.423 "
39.2° F.	62.425 "
42.8° F.	62.423 "
113.0° F.	61.823 "
212.0° F.	59.844 "

Water boils at 212° F. only when the barometer stands at 30 inches. If the atmospheric pressure be increased, the boiling point will be raised and if the pressure be lowered the water will boil at a correspondingly lower temperature. If the boiling of water be attempted in the mountains, it is usually

figured that for about every 500 ft. of ascent, water will boil at  $1^{\circ}$  F. lower temperature.

At sea level, boiling point of water is									212° F.
500 ft. below sea level boiling point of water is									213° F.
1,013	"	"	"	"	"	"	"	"	214° F.
509	"	above	"	"	"	"	"	"	211° F.
1,021	"	"	"	"	"	"	"	"	210° F.
5,185	"	"	"	"	"	"	"	"	202° F.
10,053	"	"	"	"	"	"	"	"	193° F.

### Boiling and Freezing Temperatures of Salt Water

Water when saturated with salt, boils at the sea level at a temperature of  $228.2^{\circ}$  F., the density of the water raising the boiling temperature. Sea water freezes at about  $28.4^{\circ}$  F. We are told that the Greenland Ocean freezes at  $26^{\circ}$  to  $31^{\circ}$  F. according to its saltiness. When concentrated to a specific gravity of 1.1045, sea water requires a temperature to freeze it  $18.3^{\circ}$  F. lower than fresh water. We are told that "even then the crystallizing force rejects eighty per cent. of the salt and freezes the water alone, with the result that the ice of sea water when melted produces comparatively fresh water; but such water tastes somewhat bitter and unpleasant, for it still contains some salt which was entangled mechanically in the spaces between the ice crystals." We have seen that warm water is lighter than cold water, and that water attains its maximum density at  $39.2^{\circ}$  F. As the temperature of water approaches  $32^{\circ}$  F., which is the freezing point, the increase in volume is very slow and gradual. At  $32^{\circ}$  F. water begins to turn into solid crystals of ice and expands rapidly, but water expands somewhat before freezing, while it is still liquid. This expansion of water before freezing is

a wonderful provision of nature whereby a protecting mantle of ice is thrown over the surface of waters, thus safeguarding water life and maintaining accessible liquid below for the benefit of all life and the continuance of nature's processes.

### **The Sea, the Source and Ultimate Destination of Land Waters**

The ocean is the "Home of the Waters." Water may fall upon the land, evaporate from its surface, be absorbed into the tissues of animal life or be used in the formation of the tissues of plants; it may fulfil many mechanical duties, but the ocean is its ultimate destination, and it has been fitly said that these are but delays, transformations and changes, and eventually, by springs, rivulets and rivers, it returns to the mighty reservoir, the ocean from whence it came—carrying with it all the dissolved substances gathered on its journey, principally carbonate of lime and common salt; the former is being continually appropriated by the marine animals, whereas for the latter, there is but little use. The oceans and seas occupy 72 per cent. of the surface of the globe; the total volume of the water of the oceans is about 309,000,000 cubic miles, and the average depth of the seas is about 2.2 miles. Sea water contains all known substances; at any rate in traces. The salt in solution in the ocean would provide enough material to construct the African continent in all its relief.

From the surface of the ocean a continuous invisible stream of aqueous vapor is rising up into the atmosphere, to be re-condensed and precipitated as rain or snow. Approximately 72 per cent. of the rainfall returns directly to the sea and the remainder

falls on the land, collects into lakes and rivers and penetrates into the earth to appear again as springs or to form underground water courses and reservoirs, into which we sink deep or driven wells.

All the water that is indispensable to the existence of human beings, animal and vegetable life and necessary to that industry which is the accompaniment of modern life, arises from the condensation, in the form of rain and snow, of atmospheric water vapor, evaporated by the sun from the waters of the earth. If the land were level and the water from the heavens fell uniformly throughout the globe, the water so falling would, in a year, equal a layer of 33.5 inches in thickness, which is equivalent to the eleven-thousandth part of the volume of the waters of the ocean.

Fresh water is, therefore, made by nature from the salt water of the ocean, and man occasionally is compelled to obtain fresh water by distillation, which is but evaporation and re-condensation. Unless such fresh water artificially obtained is well aerated, it will have a flat repulsive taste and generally a somewhat disagreeable odor.

### **Steam**

Steam is the elastic aëriform fluid or the vaporous substance into which water is converted under certain conditions of pressure and relatively high heat. In its perfect state, steam is transparent, colorless and invisible—a gas; when visible to the naked eye in the form of a cloud, it is then condensed and has become water.

### **Oxygen in Water**

All water contains air; without it, the water would be lifeless, insipid, flat and unpalatable. No life

could exist in water robbed of its air. If fish were put into water that had been boiled and the air expelled, they would come to the surface to breathe the atmospheric air and would eventually die unless the water was aerated, i. e., supplied with a normal amount of oxygen. Those who have had experience with aquariums know that organisms die if they are kept in distilled or flat water, freed from certain mineral matter and much of its natural oxygen. This merely indicates that fish cannot live without air and food. All natural waters contain air, but the air in water has double the quantity of oxygen in it that is present in atmospheric air, and for this reason fishes have only to pass through their gills (which fulfil the same functions as our lungs) half the quantity of water they would otherwise be required to handle. Aquatic plants give off oxygen to the water and the fishes breathe it, giving out themselves carbonic acid on which the plants thrive; "so beautifully does nature arrange the minutest detail of her work." Coles-Finch tells us that to manage an aquarium successfully, the first consideration must be the balancing of animal and vegetable life.

### **Water as a Solvent**

Water is the most powerful and general solvent found in nature, hence water is never found in an absolutely pure state, for it will hold in solution almost all bodies. There is probably no terrestrial substance which, under certain favorable conditions, is not to some extent, soluble in water. As a rule water when hot is capable of holding a larger quantity of solids in solution than when cold; such hot water when cooled precipitates the surplus

solids in the form of crystals, but after cooling, if the remainder of the water is evaporated, other crystals will appear.

### **Pure Water an Ideal Substance**

Absolutely pure water is never found in nature. In a strictly scientific sense such pure water is but a chemical ideal. The preparation and preservation of water in a pure state are problems of the greatest difficulty, for water dissolves and absorbs a varying quantity of nearly all substances with which it comes in contact. One may truthfully say that no man has ever seen or handled absolutely pure water. Natural waters are complicated mixtures, but the percentage and nature of the impurities obtained in places, free from human pollution, are generally such that they can be classified as nominally pure waters, having no appreciable deleterious action on man or on industrial and technical processes. For general purposes it is neither necessary nor advisable that water should be robbed of all its mineral content, i. e., temporary and permanent hardness.

### **The Common Origin of all Water Supply**

All sources of water supply have but one common origin, being derived from condensation of the aqueous vapors in the atmosphere, either as rain, snow, hail or sleet proceeding from the clouds, or dew and frost from the immediate atmosphere. It is also well known that all such moisture will ultimately (1) either evaporate and return invisibly to the atmosphere, (2) be absorbed by vegetable or animal life, (3) percolate into the earth to different depths where it forms the subterranean ocean, whence it re-appears as springs or wells, or (4) it

may be collected on the surface and form streams, ponds, lakes and rivers. Some of the water will fall directly into the ocean, but that which falls on land may be expected to eventually join the mighty ocean and return by evaporation to the atmosphere, prepared to continue the apparently endless cycle necessary for the continuance of life on this planet.

### **Rain Water and Its Purity**

The general impression that rain water is an ideal source of drinking water is erroneous. All water, whether fresh and nominally pure or salt and full of impurities, is originally derived from the rainfall. Water, we have seen, is the most universal solvent known, dissolving all the known gases and a large percentage of the solid bodies, and carrying other matter with it in suspension in its journey through the atmosphere. The possibility of contamination of rain water near cities and manufacturing centres is vastly greater than in lightly populated or uninhabited districts. In the purest rain water, traces of carbonic acid, ammonia and sea salt are to be found. Rain water rarely contains less than 1 grain of solid matter per gallon, and in towns 3 or 4 grains and even more. This solid matter is equivalent to about 3 lbs. per acre of ground for each 1 inch of rainfall. Rain water, an authority has said, when collected, say 25 miles from a town or city, cannot be considered pure, for it will contain more organic matter than deep well water. From experiments and analysis of rain water in the neighborhood of Caen, France, Pierre found that a thousand acres of land received annually from the atmosphere by means of rain:

Chloride of Sodium	33.4 lbs.
“ “ Potassium	7.3 “
“ “ Magnesium	2.2 “
“ “ Calcium	1.6 “
Sulphate of Soda	7.5 “
“ “ Potash	7.2 “
“ “ Lime	5.5 “
“ “ Magnesia	5.3 “

The total amount of impurities in the Leeds and Garforth (Britain) rain, as determined at the experimental station 6 miles from the manufacturing city of Leeds, is given as follows in tons per sq. mile per annum:

Class	Items		Totals
(1) Insolubles	Carbon	87.1	
	Tar	42.6	
	Ash	262.5	332.2
(2) Sulphur Compounds	Sulphuric Acid	8.5	
	Sulphates	77.0	
	Other Sulphur Compounds	19.1	104.6
(3) Nitrogen Compounds	Ammonia	4.1	
	Nitrates	0.14	
	Albuminoids	1.0	5.24

Angus Smith found in London rain water 2 parts of sulphuric acid per 100,000, and in Manchester and Liverpool water 4 to 5 parts. Prof. Church found in rain water many miles from the ocean, 6 grains of chloride per gal.; at Perugia, Italy, 75 miles from the sea, Belluci found 5 milligrammes per litre. Rideal says, “Country rain may contain pollen granules, dried tissue, spores of fungi, insects and bacteria, so that it must always be properly filtered if used for drinking.”

Miquel found that rain water showed on an average 4.3 bacteria per c.c. in the country (Montsouris) and 19 per c.c. in Paris; snow showed more bacteria than rain. Janowski found in freshly fallen snow from 34 to 463 bacteria per c.c. of snow water.

In the British Report of the Royal Rivers Pollution Commission of 1874, it was stated that one-half pint of rain water often condenses out of about 3,373 cubic feet of air. This is said to be the quantity of air a man breathes in 8 days; so that in drinking a tumblerful of such water which has washed a dirty atmosphere, he swallows an amount of impurity which would only gain access to his lungs by breathing in 8 days.

### **Rainfall**

The supply of water in any region is principally dependent upon the annual average rainfall of the region itself or of the catchment area and territory that supplies the location in question with water—either surface or subterranean. The average rainfall of the world is about 33.5 inches per annum. In New England it is about 43 inches, New York State 42 inches, British Isles 36 inches, with districts as low as 14.6 inches and others as high as 176.6 inches per year. Cherra Punji (Assam) is said to have the maximum rainfall, viz.: 610 inches; a section of the West Indies averages 285 inches, parts of Brazil 276 inches and Coimbra, Brazil, 224 inches. There are also rainless districts on the globe and the Sahara Desert, part of Arabia, Desert of Gobi and part of Mexico, Chili and Peru have seldom experienced rain. It is said that one-

quarter of the world has less than 12 inches of rain per year, another quarter has 12 to 24 inches, a third quarter 24 to 48 inches and the remainder has to contend with over 48 inches rainfall per annum.

### Temperature of Water

The waters of the Ocean, Lakes, Rivers and Atmospheric Rains have very variable temperatures, but the deep waters of the earth, the subterranean rivers and seas have generally a temperature peculiar to their depth below the surface. It is found in temperate regions that at a depth of about 80 to 100 feet in the earth, there is generally an unvarying temperature. All the world over, there must be a constant temperature at a constant depth. It is reported that in Java at 2 to 3 feet, and in India at a depth of 12 feet from the surface, the thermometer is constant all the year round. It is said that in the Catacombs of Paris, 100 feet below the surface, there is no change of temperature. Below the invariable stratum where the influence of the seasonable changes is negligible, the temperature becomes greater as we go down deeper, because of the internal heat of the earth. Coles-Finch has estimated that there is an average increase of  $1^{\circ}$  F. for every 66 feet as we descend nearer the center of the earth below the line of constant temperature; this is equivalent to  $80^{\circ}$  F. for every mile. At a depth of about 2 miles below the earth's surface, the temperature would be the same as the boiling point of water at the surface; at a depth of 20 miles, the temperature would be  $1760^{\circ}$  F. and at 50 miles,  $4000^{\circ}$  F. at which point every known

solid substance would melt. Temperature of wells in British chalk formations at various depths gave:

150 feet deep	53° F.
250    "    "	56° F.
650    "    "	65° F.

which gives an increase of 12° F. in 500 feet, or 1° F. for each 41.66 feet in depth. Careful observations taken during the building of the Simplon Tunnel gave an increase in temperature of 1° F. for every 71.5 feet in one vertical gradient, and 1° F. for every 67.5 feet in another. With about 1 $\frac{1}{4}$  miles of rock over their heads the workmen encountered large quantities of hot water with a temperature ranging from 104° to 117° F.

At Sperenberg, Berlin, there is a boring 4194 feet deep through rock salt, which produces brine. The increase in temperature recorded in this boring as the work progressed was:

At a depth of 1,000 ft.	increase of 1° F. for each 42 ft.
"    "    "    " 2,000    "    "	"    "    57    "
"    "    "    " 3,000 to 4,000    "    "	"    "    95    "

The following are the temperatures of the water from several renowned borings and they show an average increase of temperature due to the earth's internal heat of 1° F. for a descent of from 40 to 55 ft.

Grenelle and Passy	82° F.
Kissingen	66° F.
St. Louis	73.4° F.
Louisville	76.5° F.
Charlestown	87° F.

### Classification of Water Supplies

The importance of a supply of wholesome drinking water to the individual, family or community

cannot be exaggerated. Primitive settlers located in close proximity to a reliable supply of good fresh water, and towns have sprung up on the banks of rivers, lakes and in the vicinity of deep wells and springs. It has been truly said that the population of old gathered round healthful and maintained water supplies, and water has ever been the valuable and magnetic core of human, and later of agricultural and industrial centers.

The British River Pollution Commission has stated that "In respect of freedom from the most objectionable of impurities, organic matter (organic carbon and organic nitrogen) waters range themselves in the following order:

- I. Spring water
- II. Deep well water
- III. Rain water
- IV. Upland surface water,

the last named being much inferior to the first three."

In respect to wholesomeness, palatability and general fitness for drinking and cooking, the waters derived from various sources may be classed in the following order:

- |            |   |   |
|------------|---|---|
| Wholesome  | { | 1. Spring water                             |
|            |   | 2. Deep Well water                          |
| Suspicious | { | 3. Upland Surface water                     |
|            |   | 4. Stored Rain water                        |
| Dangerous  | { | 5. Surface waters from cultivated land      |
|            |   | 6. River water to which sewage gains access |
|            |   | 7. Shallow well water.                      |

Natural waters group themselves, from a bacteriological standpoint into four well-marked

classes, according to their relation to the rich layer of bacterial growth upon the surface of the globe.

- A. *Atmospheric Water*—Which has never been subject to contact with the earth.
- B. *Surface Water*—Immediately exposed to such contamination in streams and pools.
- C. *Stored Water*—In lakes and large ponds where storage has reduced bacterial numbers and produced a state of comparative purity.
- D. *Ground Water*—From which previous contamination has been even more completely removed by filtration through the deeper layer of the soil.

### Hardness and Softness of Water

When rain water has filtered through rocks and soil and reappears in the form of a spring or stream, or is brought to the surface by means of wells or borings, it is more or less charged with earthy salts in solution. When such salts are present in small quantities the water is termed "soft"; when the water contains relatively large proportions, it is said to be "hard." Rain water contains few salts in solution and is, therefore, universally known as a "soft" water. The hardness of rain water varies from  $0^{\circ}$  to  $10^{\circ}$ ; the latter degree is surprising, but was obtained near the seashore at Land's End, England, 100 feet above the sea, when the wind was blowing strong from the ocean. In rough weather authorities estimate the average hardness of rain water at about  $.62^{\circ}$ . One degree of hardness implies that each gallon of water contains 1 grain of Bicarbonate or Sulphate of Lime and that 1 lb. of

soap for each degree of hardness will be required to soften 833 gallons of water; or, according to Clark's scale,  $\frac{1}{4}$  oz. of soap will remove  $1^{\circ}$  from 10 gallons of water. The term "hard" as applied to water had, primarily, reference to the harsh or hard feeling in washing the hands with soap, when "instead of forming a smooth elutriant coating which removes grease and dirt, the latter disappears and there is a curdy appearance in the wash water. This consists of insoluble compounds of the earthy metals in the water (mainly Calcium and Magnesium) with the fatty acids in the soap."

It is well known that "soft" water readily dissolves soap and because soapy waters are sticky and easily form air bubbles, a lather or soapsuds is easily made in soft waters with an economical expenditure of soap, physical effort and time.

The difference between hard and soft waters consists primarily in the relative quantities of Bicarbonate of Lime contained therein.

Water of less than  $5^{\circ}$  of hardness is considered very soft.

Water from  $5^{\circ}$  to  $10^{\circ}$  of hardness is considered fairly soft.

Water from  $10^{\circ}$  to  $15^{\circ}$  of hardness is considered normal.

Water from  $15^{\circ}$  to  $20^{\circ}$  of hardness is considered fairly hard.

Water from  $20^{\circ}$  to  $30^{\circ}$  of hardness is considered hard.

Water of more than  $30^{\circ}$  of hardness is considered very hard.

There are two kinds of "hardness"—permanent and temporary. Permanent hardness is primarily due to the presence of Sulphate of Calcium. Temporary hardness is due to Bicarbonate of Calcium (lime). Temporary hardness can be removed by boiling, but permanent hardness cannot be similarly overcome, hence the generally accepted designation—temporary, or the easily removable, and permanent, the immovable.

The simplest way of softening water and reducing or eliminating its temporary hardness, is by boiling, and the greater the heat, the greater will be the percentage of contained matter which will be precipitated.

Temperature Fahrenheit	Percentage of Temporary Hardness Deposited
217°	50.0
227°	60.5
236°	69.0
250°	81.7
261°	90.3
290°	100.0

By this method of treatment, the Bicarbonates of Lime and Magnesia are decomposed into free carbonic acid, which escapes, and insoluble carbonate of lime and magnesia, which are precipitated. The hardness of water that cannot be removed by boiling, i. e., the permanent hardness, consists principally of the Sulphates of Lime and Magnesia. The Chlorides and Nitrates of Calcium and Magnesia are likewise not precipitated by drawing off the carbonic acid and they also remain in solution after boiling as permanent hardness.

The removal of temporary hardness by boiling is expensive; it, moreover, causes a loss of water and the product has a flat, insipid taste because the dissolved gases have been driven out.

Clark patented a process in 1841 which consists of adding Lime Water to neutralize the excess carbonic acid, keeping the earthy carbonates in solution as bicarbonates. Liquid treated in this way retains its permanent hardness, plus about 2 grains per gallon of calcium carbonate and a great part of the magnesia. The precipitate carries down heavy

metals, such as iron and manganese and also entangles much of the organic matter, organisms and mud, so that much improvement is almost always obtained by the use of Clark's method. The removal of permanent hardness is seldom attempted in water for drinking and other domestic purposes. For boiler use and certain manufacturing purposes, Caustic Soda or Carbonate of Soda and sometimes other alkaline mixtures are added to water, with or without the addition of lime, the composition and amount depending on the chemical characteristics of the water to be treated.

Sohn has suggested the following general classification of drinking waters, having due regard to source, relative hardness and pollution:

- A. Upland Surface Waters with impurities chiefly organic; total solids 2 to 10; hardness low—1 to 5.
- B. Surface Water flowing from cultivated land. Less pure than A; total solids 10 to 30; hardness 5 to 25.
- C. Water from Shallow Wells; should be used with great caution; composition very variable; often dangerously polluted.
- D. Water from Deep Wells; less liable to organic contamination. Sometimes very hard; sometimes very soft.
- E. Rain Water. Very soft; usually traces of organic matter, ammonia nitrates, chlorine, etc.

Sohn states that in addition to carbonates and sulphates of lime and magnesia, other substances present in water in relatively small quantities, are common salt, nitrates, silica, ammonia compounds, also living organisms and impurities arising from contamination.

The British Rivers Pollution Commission considered broadly three classes of water in relation to hardness and classified these in relation to their source.

1. *Soft Waters* from Igneous Rocks; dissolved solids up to 3 parts per 100,000.
2. *Moderately Hard Waters* from sandstone and shale; dissolved solids from 3 to 15 parts per 100,000.
3. *Hard Waters* from chalk and limestone, dissolved solids from 15 parts up to 77.5 parts per 100,000.

In some parts of the United States the well waters, and very occasionally even the surface waters, are so hard as to be almost or quite useless for washing and even for drinking. Hough and Sedgwick have said, "It has never been shown that moderately hard waters are necessarily any more harmful for drinking than soft waters. Persons used to either kind are apt to suffer temporary disturbances, such as diarrhoea, when they change suddenly from one to the other; but otherwise, no great or permanent harm ordinarily happens. If, however, a drinking water is very hard and heavily charged with mineral salts, so that it becomes eventually a mineral water, it may be unfit for regular use" (domestic or industrial).

Ground Waters are apt to be hard, i. e., they will most probably contain large amounts of lime and magnesia in solution. Two conditions must contribute to the making of hard ground waters:

- First.* There must be present the hardness-producing materials.

*Second.* Carbonic Acid must be present, i. e., conditions must be favorable for dissolving the hardness-producing materials which the water encounters in its travel.

An authority has aptly said: "The hardness of water depends more upon the richness or fertility of the soil upon the catchment area than upon the amount of lime in the various materials through which the water flows, provided, of course, that the land contains an ample amount of lime which can be taken up." In the making of hardness, water dissolves lime from the ground it passes through, but it must needs draw its Carbonic Acid to dissolve the lime from the organic matter in the soil.

The Report of the British Rivers Pollution Commission gives the following table:

No. of Cities	Population	Degree of Water Hardness	Rate of Mortality
26	73,000	Under 5°	29.1
25	81,000	5° to 10°	28.3
60	44,000	Over 10°	24.3
London	3,250,000	16° to 32°	24.6

The opinion of the Commission was that "Both soft and hard waters are equally wholesome and we give no preference to soft water." Coles-Finch discussing this matter says, "Hard water is beneficial to the human system to a far greater extent than we are generally aware, especially to children and young people, the lime in the water helping to build up their frames. It has been noted that in hard water districts the absence of rickets is apparent and the inhabitants generally have better teeth than those living in soft water districts."

At one time it was thought that hard or even moderately hard waters were deleterious to the hu-

man system. Some authorities have maintained that very hard water produces a prevalence of gouty and calculous disorders and goitre. Dr. Tyrrell has said that "So great is the proportion of mineral substance taken into the system in drinking water that it is safe to assert that, if after maturity was reached, only distilled or other absolutely pure water was partaken of, life would be prolonged fully ten years. Up to the mature age it would be inadvisable as the salts are necessary for bone formation." Excessively hard waters may, under certain conditions, prove injurious and possibly, in a few isolated cases, hard water may, perhaps, prove deleterious to persons of advanced age, but Tyrrell's sweeping condemnation of hard waters is not substantiated by facts and his premise in regard to the use of moderately hard waters by persons of mature age is diametrically opposed to the truth as demonstrated by scientific research.

The British Commission reported, to their own surprise, that "Both soft and hard waters are equally wholesome," and they amazed many of the experts of their day by finding that, based on the facts collected, they could from the standpoint of health "give no preference to soft water." As a matter of fact, the statistics which they compiled clearly show the superiority of hard water. Cities with water under  $5^{\circ}$  of hardness had a death rate 20 per cent. in excess of that of cities using water containing over  $10^{\circ}$  of hardness, and the colossal London, using hard water and harboring poverty, vice and with conditions favorable to the propagation of disease in its poor and thickly populated sections, showed better than 18.5 per cent. less mor-

tality per thousand people, than the average of 26 small cities using soft water.

The *Lancet* has said, "It is a popular but probably wrong impression that hard drinking waters are prejudicial to the health and, moreover, are injurious to delicate skins when used regularly for ablutionary purposes. Gout, kidney disease and dyspepsia, by an interesting line of reasoning, have been supposed to be due to or aggravated by, the drinking of excessively hard waters. Some mysterious connection between the chalk of the water and the formation of 'Stones' in the kidneys, or of 'chalk' in the joints in gout is a favorite speculation with many; but in the history of the world's water supplies there is no trustworthy evidence that the drinking of hard water influences for the worse these diseases. The idea is, in fact, chimerical."

Wanklyn, referring to the large amount of solid matter in London drinking water as compared with that of Manchester and the splendid waters of Loch Katrine, used to supply the city of Glasgow, said "The healthiness of London is higher than either, and I am warranted in saying and maintaining that high solid residue in drinking water can have no very markedly injurious effect on public health. London proves it. Here the major part of the solid residue consists of Carbonate of Lime; subtract this and the rest of the solid residue will not be much higher than the water of Manchester and other soft waters."

Gaertner states that the valley of Bürgel in the Thuringerwald has always drunk with impunity from time immemorial a water with the extraordinary hardness of  $129^{\circ}$  (Clark) of which  $110^{\circ}$  is calcareous and  $19^{\circ}$  magnesium. He also cites

Göttingen with  $56^{\circ}$  and Wurtzburg with  $37.5^{\circ}$ . Health does not demand the condemnation of the average water for its hardness, nor the conversion of the hard, bright, sparkling water into soft insipid "treated" water. Pure spring water is always much better and more healthful, when it is procurable, than distilled or boiled water. Soft water is undoubtedly much pleasanter than hard water for external application, but this fact is no justification for the saying that "it is better to deposit salts in a hot water kettle than to burden the human system."

A lack of mineral substance in water taken habitually is far more injurious to health than the use of a water containing an excess quantity of such salts. Very soft waters are not wholesome and should be avoided. Roese, a long time ago, made some interesting investigations regarding the deleterious effect of the constant use of drinking water, very poor in lime. He found that wherever extremely soft water was used, the people are of small stature and chest measurement, and have a tendency to tuberculosis. He stated that "it is important that the drinking supply should have chalk in it, because a very soft water helps to decay the teeth and has an injurious effect on bodily growth and also on the military resistance of men and the suckling power of women."

Surgeons of the French Navy have emphatically affirmed that distilled water is prejudicial to health on account of the absence of mineral salts needed for body nutrition. They attribute numerous cases of tubercular condition among sailors to the demineralization of the water, the evaporators on board ship making fresh water from the water of

the ocean. Theoretically there are sufficient mineral constituents in the average diversified food to supply the proper amount of salts needed for bodily growth, but the necessary mineral constituents are apparently much more easily assimilated from water than from food, for in the former they are directly diffusible and ready for immediate absorption, a condition that does not exist with solid foods in general. It appears, therefore, that if soft water has, of necessity, to be used, foods with excess mineral content, to supply the water deficiency, and of a nature that will tend to permit of the utilization of such salts by the human system, should be used in conjunction with such water.

### **Impurities in Water**

The impurities in water may be classified under either one of two prime divisions—organic or inorganic. Inorganic matter as we have seen, consists of various salts which contribute to the temporary or permanent hardness of water. Mineral springs contain bicarbonate, sulphates, sulphides and chlorides of various metals, such as magnesia, potash, calcium and soda, also carbonate of iron, silicic acid, etc. Ammonia—nitrates, or nitrites, found in water indicate the presence of organic (vegetable or animal) matter which is undergoing decomposition. Water polluted with sewage generally shows traces of contamination in the products of organic decomposition, such as ammonia, nitrates, nitrites, while chlorides, phosphates and other salts will also be present. Bacteria exist wherever sewage is deposited in water and under certain conditions such bacteria may be of a pathogenic nature.

Sewage-polluted water is generally pleasant to the taste owing to the chlorides and other salts present. The old-fashioned method of testing water for relative purity by means of taste and appearance is a relic of the blissful days of gross ignorance; a "sparkling appearance and an agreeable flavor in a water are compatible with a high degree of contamination." Scientists have found that the presence of bacteria in numbers even as high as 2,000,000 per cubic centimeter does not impair the transparency and clearness of water, therefore, the archaic but popular method of testing water for drinking purposes by transparency and flavor is no true criterion of purity, unless it is also well known that the water comes from a source which carries with it no danger of contamination by sewage and animal life or the discharges and pollution from manufacturing establishments.

It is apparently impossible to establish a standard of water purity based on chemical examination. The theory of today regarding the harmfulness of water is that the deleterious effects are caused by the presence of noxious micro-organisms in the water and that "the results of chemical analyses have their value in the light that they throw on the quality of the water, from the standpoint of the extent of bacterial contamination." The organic impurities in water consist of small living organisms, eggs of parasitic worms, bits of tissue from animals, spores, infusoria and bacteria. Some of these impurities are harmful, others are not harmful in themselves but they are important inasmuch as they may suggest the nature and origin of the water contamination. Most water, as found and used for drinking purposes, contains bacteria, al-

though in pure spring water, rising from a good depth and having been purified by percolation through nature's filter, bacteria may be absent. It is said that over 200 different forms of bacteria have been studied in water. Fortunately most of them are harmless and in fact some may serve us the good turn of destroying other organic matter present in the water. Bacteria in water suggests the contamination of water and the number of bacteria suggests the extent of the contamination. Noxious bacteria may be present in polluted waters because of the contamination, whereas such pathogenic bacteria could not be present in water proceeding from a natural, wholesome source. Two of the principal epidemic scourges of the world, viz.: typhoid fever and cholera, have been proved to be disseminated mainly through water contaminated with sewage.

Water is generally classified and graded substantially as follows:

- |                            |                         |
|----------------------------|-------------------------|
| A. <i>Physical Data</i>    | 1. Turbidity            |
|                            | 2. Color                |
|                            | 3. Taste                |
|                            | 4. Odor                 |
|                            | 5. Original Temperature |
| B. <i>Solid Impurities</i> | 1. Suspended solids     |
|                            | 2. Colloidal substances |
|                            | 3. Matter in suspension |
| C. <i>Chemically</i>       | 1. Organic              |
|                            | 2. Inorganic            |

The solids are generally divided into groups according to their physical state; the temporary and permanent hardness is determined and when desired, the nature and extent (quantitative and quali-

tative) are determined by complete analysis. Most of the organic matter is either in solution or suspension; only a comparatively small amount is found in a colloidal state, such as certain albuminoid and humous compounds.

The bacterial content of ordinary soil is very large, ranging we are told, from 10,000 to 5,000,000 per gram of soil, while in polluted soil, the bacterial content may rise as high as 100,000,000 per gram. Such an extent of bacterial life does not continue far below the surface, for at a depth of 10 ft. scientists tell us there is practical sterility. Water that has been percolated through upper layers of soil will, of course, carry off very many of the germs encountered in their travel, including pathogenic ones—a menace to health. Subsoil water is in general almost free from living and suspended impurities, since it has passed downward through several feet of filtering soil, alluvial gravel or sand, overlying the bedrock or floor, so that the wonderful processes of natural purification may have had time to be fulfilled.

All authorities agree that man and the works and possessions of man pollute the waters of the earth to his own detriment. Natural waters, whether hard or relatively soft, are generally fairly healthful, but man is unfortunately the author of epidemics and ravaging diseases, because in his arrogance and ignorance he pollutes nature's water courses, sets at naught her laws and as nature's insurgent son, believes that there are no barriers that cannot be removed if he so elects, and no delicate condition of equilibrium that he cannot upset and still avoid all evil consequences and the denunciation and punishment which follow all who violate nature's im-

mutable laws. The history of the world proves that man has suffered greatly by nature's prompt and unfailing retribution for his short-sighted errors and intolerant and selfish aggressiveness, but it has taken ages for man to see it. The plague and scourges of history were not the work of the devil as was once believed, but were the natural reaction following man's violation of the laws of the universe. If man continues to pollute nature's streams and lakes and to take his drinking water from such contaminated sources, he will suffer. If man drinks water from a shallow well, located in his farm yard where waste matter, animal and domestic, seeps through the top soil, which is inevitably charged with prolific bacterial life, he will suffer and all the doctors and dope in the country cannot keep a man in health who persists in violating a fundamental principal of nature, decreed from the birth of this inhabited world to function for the benefit and continuance of biologic life.

The waters of the river Seine, above Paris, average, we are told, 300 bacteria per cubic centimeter; within the city limits, after sewage has been discharged into it, the bacteria increased to 200,000 per c.c.; Prudden found in the Hudson river, above Albany, over 2,000 bacteria per c.c.; Croton water which is used in New York City averaged 309 during the years 1886-1890, with a maximum of 1950 and a minimum of 20 per c.c. Crude sewage at Lille, France, showed 5,000,000 bacteria per c.c. Brockton, Mass., 3,150,000; Boston, Mass., as high as 11,487,500 during September, 1903, and as low as 587,100 in November of the same year—averaging 2,800,000 for seven years. Paris showed 10,000,000 per c.c.; Belfast, Ireland, about the same.

The average European city has shown from 1,000,000 to 5,000,000 bacteria per c.c., depending on peculiar conditions and the season of the year; London, 2,000,000 to 11,000,000; Columbus, Ohio, showed 320,000 to 27,000,000 with an average of about 3,600,000 per c.c. By no stretch of the imagination can sewage, therefore, be considered healthful to mix with the drinking water of man or any other form of animal life.

The progressive pollution of ground water, as evidenced by the water of a shallow well, is well illustrated by the experience of occupants of the Military Camp at Algiers, reported by Vincent in 1905:

	Bacteria per c.c.	Bacillus coli per c.c.
Before arrival of troops	200	0
6 days after troops arrived	770	0
14 " " " "	4240	1
41 " " " "	6960	2
60 " " " "	14900	10

Man cannot pollute nature's storehouses of water maliciously, indifferently or ignorantly without reaping in true boomerang fashion the full penalty of his crime. The Algiers well, healthful before the military occupation, was soon polluted by man with his unhygienic habits, spreading its bequeathed disease broadcast.

The bacterial content of some rivers is highest when the stream is lowest—when the sewage content of such polluted streams is least subject to dilution. In more normal or naturally-fed streams the bacterial numbers are highest when rain brings surface pollution. In lakes, seas and large bodies

of water, bacterial life decreases generally as one passes downward from the surface and outward from the shore.

Freezing water will not, as popularly supposed, kill the bacteria; it generally operates with the opposite effect. Cold or freezing positively does not render a liquid safe or comparatively safe for drinking purposes; the cold exerts a contrary influence. Prudden found that many bacteria withstand freezing and may be preserved alive in ice for many weeks, possibly months. This is true of the bacillus typhosus—the human scourge responsible for typhoid fever. The ice cut from sewage polluted streams and lakes may be quite as dangerous as contaminated water. Many cases of typhoid fever have been directly traced to the use of impure ice. Epidemics of disease have been traced to the consumption of ice cream made with contaminated water.

Houston has proved that typhoid bacilli, when placed in water, actually survived longer at low temperatures.

Temperature Fahrenheit	Typhoid Bacilli surviving after one week	Period for final disappearance of bacilli
32°	46 per cent.	9 weeks
41°	14 “ “	7 “
50°	0.07 per cent.	5 “
64.4°	0.04 “ “	4 “

Prescott and Winslow say that “almost without exception, outbreaks of typhoid fever due to polluted water occur in cold weather and this is, in part at least, due to the greater resistance of typhoid bacilli at low temperatures.”

**Shallow Wells**

The use of the shallow dug wells is an old, simple and still a popular rural method of obtaining water, which is usually hoisted by means of a hand-winch, with a rope and bucket attached, from the ground level of water saturation. Technically considered, a shallow well may be a rather deep well, i. e., deep below the surface of the ground, for the word "shallow" refers to the depth of water in a well and not to the distance of the bottom of the well from the surface of the ground. Some shallow wells, or wells in which there is only sufficient water to enable one to fill a bucket with reasonable ease, are quite a good distance from the ground surface, but the bottom of such wells is only a few feet below the line of ground saturation and as a rule only just below the line of variable saturation. The large wells of this "shallow" type used for farms and villages are connected with a hand well-pump, or are operated with a horse harnessed to a pole or a pump actuated by the wind.

The water from shallow wells is apt to be contaminated, if such wells are in the vicinity of domestic habitation, farm yards, animal barns, cesspools, etc., for shallow wells are directly fed by surface water (and this includes all forms of sewage and drainage water) which percolates through the ground and mixes with the underground water, which at times may be but a few feet below the surface. The possibilities of pronounced pollution of shallow well water in the vicinity of homes and farms are shown in the accompanying illustrations.

Shallow wells supplying one or two small houses with the drainage properly taken care of and

cleanly, hygienic conditions prevailing in general, may prove acceptable sources for the water desired in the homes; the purity of such water depends, however, on the depth and nature of the ground percolation being ample for proper filtration and upon the protection of the water by sanitary and hygienic conditions prevailing both in regard to the

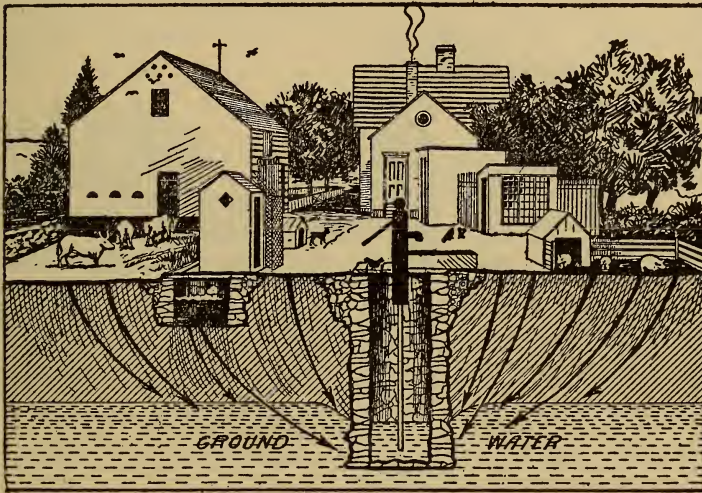


FIG. 2.

A SHALLOW WELL BADLY LOCATED IN A FARM YARD  
[Hough and Sedgwick]

occupants of the homes and the use of the entire ground surface in the vicinity of the well. Sanitary Engineers generally affirm that the water from shallow wells is wholly unfit to drink and should never be used without being sterilized. Many people seem to prefer water drawn from wells in their own rear yard to the water which may have been scientifically treated and purified by the City Water Plant. It is surprising how some people cling to the fallacy that their shallow wells must contain

pure and wholesome water, because it looks clear and tastes sweet; the fact that a cesspool or stable drainage may exist within a few feet of their well is of no interest or importance to them. An authority on the purification of water has said "It is at times amusing when a shallow well containing impure water (demonstrated by many analyses) is

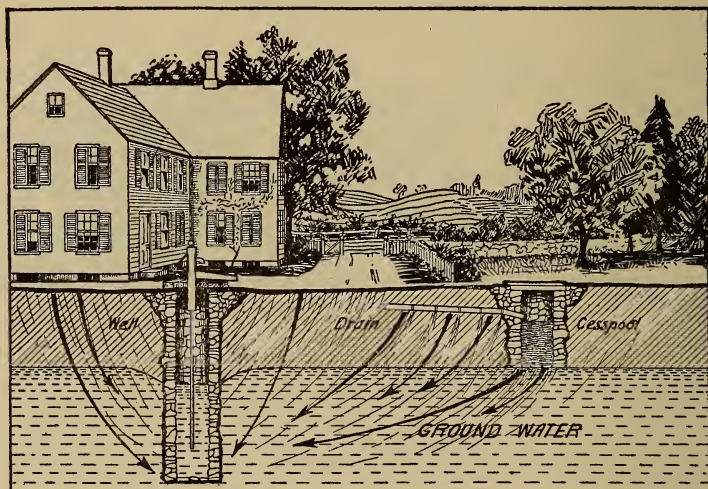


FIG. 3.

A BAD ARRANGEMENT OF SHALLOW WELL AND  
CESSPOOL

[Hough and Sedgwick]

condemned by the Sanitary authorities, to listen to the heated discussion that arises. The occupant recalls in anger the various ages of his ancestors who drank this water, the general trend of the remarks being that some secret collusion must exist between the Medical Officers and the Water authorities who have supplanted this beautiful well and insist upon being paid for a far inferior water."

The water in shallow wells may be pure and

wholesome, but the odds are that it is not. The possibilities for contamination are very great, so notwithstanding the romance and poetry associated with this form of water supply, shallow wells must succumb to advancing science, which can not only afford but guarantee protection to man from certain ills that he has periodically been prone to, but through ignorance and faulty diagnosis, has never, until comparatively recently, been able to successfully combat.

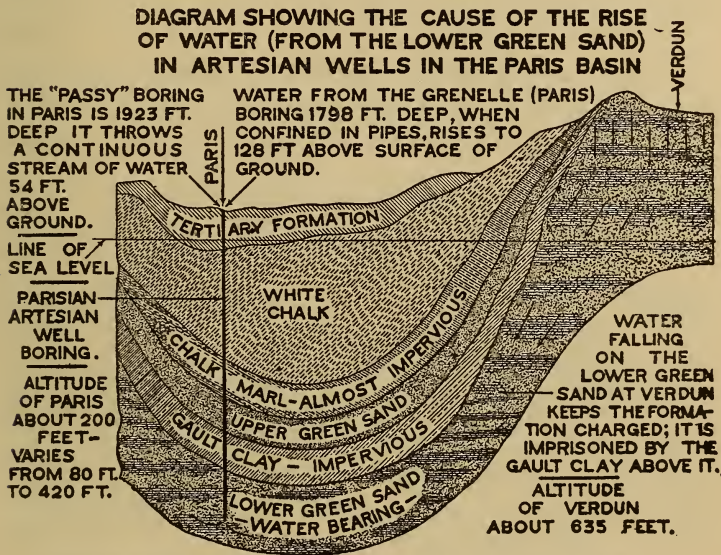
### Deep Wells

If water is required in large quantities, wells of large diameter penetrating far below the line of saturation are often sunk. Such wells, of course, fill to the line of saturation. The "Rest Level" in any well or boring is that level to which the water rises upon cessation of pumping. The "Rest Level" is fairly constant, if the amount of water extracted is not in excess of the percolation. The "Rest Level" and "Pumping Level" vary in different formations and according to local circumstances. Deep well water is usually considered far safer than the water from shallow wells; any local contamination is more diffused and there is more of a possibility of purification having been obtained by natural filtration. About sixty-eight per cent. of the Brooklyn, N. Y., water supply, or about 100,000,000 gallons of water per day is obtained from the ground, mostly from tubular wells driven in the coarse open sand and gravel. Ground water, which is water drawn from the ground by wells or taken by springs, is mostly used in America for small places and not large cities, for it is generally easier to get a little ground water than a large amount.

**Artesian Wells**

Twenty centuries ago the Chinese bored for water; the Arabs employed similar means for obtaining water in the Sahara Desert in very early days, but it was not until about 1750 that this type of well was driven in Western Europe. They were first sunk on an extensive scale by Occidentals in our so-called modern times in the French Province of Artoris, hence their name "Artesian." These wells are perpendicular borings of relatively small diameter through which the water rises to its "Rest Level," producing a constant supply of water. The "Rest Level" is not necessarily the surface and an Artesian well is not necessarily a well from which the water flows or is thrown forth in geyser fashion, but many Artesian wells, because of ground formation and geological strata, are flowing wells, and many send their water skyward, or would if it were not imprisoned, or rather harnessed, for direct useful purposes. The force by which the water in Artesian wells is enabled to rise, is derived from the natural hydrostatic pressure when the overlying impermeable strata are pierced. In St. Louis, Mo., there is an Artesian well 3843 feet deep; in Budapesth one 3182 feet deep. In Louisville, Ky., a well 2086 feet deep, though only 3 inches minimum diameter, is said to yield nearly as much water as the famous Grenelle well in Paris which, with a depth of 1798 feet, yields about 800,000 gallons of water per day. In Chicago there is a 5-inch boring which delivers about the same quantity of water each 24 hours. The "Passy" boring in Paris is 1923 feet deep and has a diameter at the bottom of 28 inches. It throws a continuous stream of water 54 feet above the level of the

ground at the rate of five and a half million gallons per day. The geological section of the Paris basin (as illustrated by the accompanying sketch with the horizontal dimensions greatly contracted) shows that the water falling on the Lower Greensand at Verdun keeps the formation charged.



SCALE FOR HORIZONTAL DISTANCES i.e. ABSCISSAE  
VALUE CONTRACTED GREATLY TO FACILITATE  
GRAPHIC PORTRAYAL OF PRINCIPLE IN SMALL SPACE .

FIG. 4.

## Springs

A spring is an overflow of water from the earth or a stream of water at the place of its source. It literally means water which leaps or bounds forth. The moisture of the atmosphere falling as rain or snow upon the surface of the earth, seeps downward, percolating through the soil, sand and porous beds until its descending travel is arrested by strata

of an impervious nature such as clay or dense rock, where it accumulates as a sort of subterranean reservoir. This underground body of water may be tapped by wells, or it may find a natural exit where the end of the geological stratum has been exposed by denudation or by a "fault," and from such a vent it may issue forth as a spring.

There are surface springs and deep seated springs, but all are caused by rainfall, ground percolation, the downward water flow being stopped by impervious strata and a geological formation which permits the water to flow to the surface of the ground in some place or other. Springs may vary in strength from time to time according to the extent of the rainfall, for, as an authority has well said, "it is evident that as much water comes out of the earth in the form of springs (visible and invisible) as soaks into it; for like a sponge, when full it can hold no more."

In this connection, it is interesting to note the relative degree of porosity of various rocks:

Rock	Absorption of water	
	As percentage of weight	
Granite	0.1 to	0.4
Gypsum	0.5 "	1.5
Slate	2.0 "	10.0
Sandstone	3.0 "	8.0
Limestone	5.0 "	8.0
Chalk	15.0 "	20.0
Plastic Clay	19.0 "	24.0
Marl and Loam	30.0 "	50.0

Where a water-bearing stratum with a hydrostatic pressure, due to its head, is imprisoned between two impermeable geological layers or beds

and finds its way to the surface, it may act as a subterranean river emerging from the ground as large or even mammoth springs. In bringing the water to the surface, a geological "fault" merely takes the place of a series of Artesian wells; the impervious strata may slope gently or abruptly downward, as shown in Fig. 5, or it may curve, as

**GEOLOGICAL SECTION  
SHOWING THE DIFFERENT KINDS OF  
WELLS AND SPRINGS ETC.  
(AFTER COLES-FINCH)**

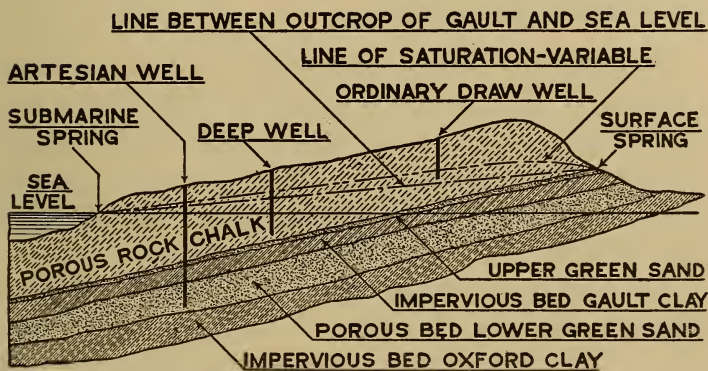


FIG. 5.

in Fig. 4, it being only necessary that the outlet of the impermeable bed be lower than that of the inlet and below the ground line of saturation.

Faults or cracks in the earth's formation have been caused by upheavals and down-throws during the process of the cooling and adjustment of the surface of the globe, the liberation of internal gases and pressure, etc. They vary in importance according to geological conditions, their extent and the effect produced. Darwin mentions the Craven

fault 30 miles long with a displacement of from 600 to 3,000 feet; also a down-throw of 2,300 feet in Anglesey and one of 12,000 feet in Merionethshire, yet on the surface there is nothing to indicate these vast differences "so completely has sub-aerial and littoral action, through the lapse of endless centuries, smoothed down and obliterated all surface indications of these mighty movements of our earth"—agencies "which seem to work so slowly have produced great results."

### Thermal and Mineral Springs

Thermal springs issue from the earth in a similar manner to ordinary springs, but they supply water either hot, warm or tepid, being properly classified as "Thermal" if they have a temperature in excess of the atmosphere in the summer season at the point of discharge.

The following temperatures of certain Thermal springs may be of interest:

Carlsbad	163.2° F.
Wiesbaden	154.4° F.
Bath—King's Well	122.0° F.
Aix-les-Bains	109.0° F. to 112° F.
Bad Gastein	97.3° F.
South Bench	186.8° F.
Mammoth Springs	123.8° F.

Thermal and Mineral springs or, as they are often called, Thermal, Saline, Medicinal or Remedial Springs, have been known and used throughout the Age of Culture and Tradition. These waters have been classified as follows:

No.	Name	Important Content or Virtue
1.	Thermal	Heat,
2.	Muriated	Common Salt,
3.	Alkaline	Carbonate of Sodium,
4.	Sulphated	Sodium Sulphite (Glauber's salt) or Magnesium Sulphite (Epsom salts),
5.	Chalybeate	Iron,
6.	Arsenical	Arsenic,
7.	Sulphur	Sulphuret of Hydrogen, Sodium, Calcium, Potassium or Magnesia,
8.	Calcareous	Earthy Substance.

Water in descending, percolating and rising through various geological formations may encounter mineral masses and become somewhat impregnated with gaseous, saline or metallic admixtures, which impart to the water peculiar properties. All substances are, to a certain extent, soluble in or acted on by water and air. The quantity dissolved is affected by the surface exposed and by the time of contact, also by the degree of solubility of the substance and the presence of accessories, like oxygen and carbonic acid. The solubility of substances, with certain exceptions, (notably Sulphate of Lime) increase with rising temperature and pressure, hence Rideal points out that many thermal deep springs contain abnormal amounts of dissolved ingredients, such as silica, which are deposited as crusts on exposure to air. Water heavily charged with minerals or salts, other than common salt, are properly termed Mineral waters and are usually named after the place of their emergence and technically classified according to the predominant constituent. Saline and Mineral waters come mainly from volcanic strata. The

springs usually disengage a large quantity of various gases, including some of the rarer ones, and are often effervescent from the escape of carbonic acid which may have been generated by

1. Oxidation of carbonaceous material.
2. Action of heat on Calcium Carbonate, (limestone, marble, chalk) or on other carbonates,
3. Decomposition of these by acids—even silicic and boric can decompose them at high temperatures.

Rideal states that no exact classification of saline and medicinal springs is feasible, since in most cases each of them contains some proportion of the characteristic ingredients of another group, but he suggests arranging them under the following heads, according to the most important constituents:

A. Carbonated	{	1. Alkaline
		2. Magnesian
		3. Calcareous
B. Chalybeate		Iron water
C. Muriated	{	Salt, sometimes
		Potassium Chloride
D. Aperient or Sulphatic	{	1. Sulphate of Soda
		2. Bitter; Sulphate of Magnesia
E. Bromide or Iodide		
F. Sulphuretted or Hepatic		
G. Arsenical		
H. Lithia.		

Mineral springs are found in the mountains, valleys and arising from the bottom of the ocean. They exist in the Rockies, the Sierras, are found on Alpine Heights and under the snow in the Himalayas.

### Water Diviner

The use of a divining-rod for discovering something hidden is apparently of immemorial antiquity. The forked twig of hazel or willow used for "dowsing" or "divining" is described by Agricola known as the "Father of Mineralogy," also by Sebastian Munster in the 16th Century. At that time it was employed in searching for mineral veins, but "by the skilled miner, who trusted to natural signs of mineral veins, they were regarded as of no avail at all." A belief in the efficacy of divining-rods for the discovery of concealed objects is mentioned in old Jewish writings, and the Roman *Virgula divina*, as used in taking auguries by means of sticks, is described by Cicero and Tacitus. It was mentioned by Valentine, the Alchemist of the 15th Century, and is said to have first been extensively used in a modern sense by the Germans, when prospecting for minerals in the Harz Mountains. The divining-rod was said by Boyle (1663) and Pryce (1778) to have value in discovering metals, but is it not strange that the same dowser would search with the same apparatus for *any* buried objects? When mining declined in Cornwall, England, the diviner transferred his attention to water finding. Vallemont wrote at the end of the 17th Century that the divining-rod of hazel (*baguette divinatoire*) was an instrument used in the pursuit of criminals and heretics. Its abuse led to a decree in 1701 forbidding its employment for purposes of justice. The Jesuit Vanière (early 18th Century), amusingly wrote describing how he exposed the chicanery of a dowser who claimed by the aid of a hazel divining-rod, to locate hidden water courses and precious

metals. In modern times the professional dowser is a "water finder." His predecessors in the art have progressed through the various stages of fortune telling, metal searching, criminal hunting and the location of buried treasures. The romance of the ages would fittingly place the supposed virtue of the hazel twig as analogous to the fairy wand, the fabled staff of Mercury or Hermes, or the golden arrow of Albaris, but we are told by enthusiastic believers that the divining-rod is a practical instrument and of far more than mythological or superstitious interest. These are not the "days of miracles," nature's laws are immutable and they do not permit of jokes or relapses from a plane of unchanging sanity.

The hazel divining-rod, with its supposed magical powers, is an analogue to the witch's broom stick, the burning of hazel nuts for the magical investigation of the future and the planchette of that class of divination branded as spiritualism. Prof. Barrett, of England, has written "I have no hesitation in saying that where fissure water exists and the discovery of underground water sufficient for a domestic supply is a matter of the utmost difficulty, the chances of success with a good dowser far exceed mere lucky hits." An investigator fittingly asks, "Is this due to any special faculty in the dowser or has the twig itself anything to do with it?" Much of the work of the diviner, if not all, is mere stageplay and the theory advanced that there is any direct connection (sympathy, electrical, magnetic, mechanical vibrations or otherwise) between the forked twig and the water, metal, jewels, criminal or any lost object of any nature, is thoroughly repudiated

by science. Professors Barrett and Janet apparently both ascribe the phenomenon to "motor-automatism" on the part of the "diviner," or in other words a "reflex action excited by some stimulus upon his mind, which may be either a subconscious suggestion or an actual impression, obscure in its nature, from an external object or an external mind." This is a charitable attempt at an explanation. The divining-rod being thus "an indication of any subconscious suggestion or impression," may operate fallaciously and if the mind of the dowser is the important factor in the search, why bother hunting for a hazel twig before going into what is apparently a sort of half-baked trance of divination? A writer has said that "the dowser's power lies beneath the level of any conscious perception and the function of the forked twig is to act as an index of some material or other mental disturbance within him which otherwise he could not interpret." This wonderful invisible force can suddenly and violently move the dowser's hands. Why can he not put out two fingers and see his fingers twist or would that method of expressing forces, psychologically recorded, lack in dramatics and be insufficient because of the absence of some tangible symbol of magic? It is said that some dowsers use a willow, beech or holly twig; others even a piece of wire or watch-spring, and one investigator makes the pithy statement "The best dowsers are said to have been generally more or less illiterate men, usually engaged in some humble vocation." The theory has been advanced and accepted by many, that dowsers are exceptionally sensitive to hygrometric influences. What has this attempted ex-

planation to say about dowzers who locate iron, buried treasures or even criminals and non-believers in churchly creeds? It is difficult to reconcile the affinity of a dowser for water with the claimed locator of minerals, valuables, fugitives from justice or men of heterodox beliefs.

Witchcraft has been relegated to oblivion but superstition, a similar relic of barbarism, dies hard. Implanted in the human mind for thousands and thousands of years, its imprint is difficult to eradicate, especially as man is prone to accept beliefs without the exercise of his inherent reasoning power. The searchers for water with a divining-rod must be supplanted by a trained engineer, who works not with a talismanic or magical instrument of the fanatical or supernatural, but with a definite, scientific and geological knowledge of the district to be investigated, coupled with practical skill, the cognition that comes from technical training and experience and the whole blended with a most admirable quality popularly designated as common sense.

### **Rivers**

A river is a stream of water flowing in a definite channel or bed to the ocean, a sea, lake or into another stream. A river is generally a large or considerable stream of water, smaller streams of a similar nature being designated as tributaries, rivulets, brooks, creeks, rills, etc. The size of rivers above any tidal limit and their average fresh water discharge are proportionate to the extent of their basins and the amount of rain which falling over these basins, reaches the river channels in the

bottom of the valleys, by which it is conveyed directly or indirectly to the sea. The basin of a river is the expanse of country bounded by a winding ridge of high ground over which the rainfall naturally tends to fall toward the river traversing the lowest part of the valley. The proportion of rain falling on a river basin, which actually reaches the river, depends very largely on the nature of the geological and surface strata, the slope of the ground, extent of its "vegetation" covering and the season of the year. It is said that "the available rainfall has been found to vary from 75 per cent. of the actual rainfall on impermeable, bare, sloping, rocky strata to about 15 per cent. on flat, very permeable soils." Rivers rise close to the highest part of their basins, generally in hilly regions; their fall is rapid near their source and rapidly diminishes; they begin mostly as relatively small torrents with irregular flow, and end when they drain large basins, as gently flowing rivers with a comparatively uniform discharge. The velocity of a river depends upon the inclination of its bed and partly on the volume of water, and it varies throughout its course accordingly. It has been said that the swiftest portion of a river is about one-third of the way below its source, the mean velocity is found at about one-tenth of its depth from the surface, and at the bottom the velocity is the least. The "transporting" power of water depends upon its velocity and investigators tell us that it increases as the sixth power of the velocity, or, if the velocity be doubled, the motive or transporting power increases sixty-four fold.

The following table has been prepared to illus-

trate the carrying power of moving waters, with regard to solid matter in suspension:

Rate of Flow in feet per minute	Nature of solid matter that can be transported
15	Fine mud
30	Fine sand.
40	Sand the size of a pea.
60	Fine gravel.
120	Round pebbles 1 inch in diameter.
180	Angular stones as large as a hen's egg.

Turbid waters are those which are muddy and thick, i. e., those in which the natural sediment or foreign matter held in suspension is kept disturbed so that it cannot readily settle. The velocity of rivers and flowing water tends to maintain the condition of turbidity, whereas tranquil, stationary waters would tend to overcome it by gravity settling. Next to the prime sanitary or hygienic properties of water, there is no feature of more general interest and importance than turbidity. All river waters are more or less turbid, but they vary greatly in degree, the difference being primarily due to the general character or nature of the catchment areas. The Merrimac and Connecticut rivers in New England, draining areas largely covered with glacial drift of a sandy character, are but little subject to turbidity. It is said that they do not carry more than 10 parts per million of suspended matter, as an average, throughout the year. The Missouri river, on the other hand, is a turbid stream, carrying the largest amount of sediment of any of the American rivers which are largely used as a source of water supply. Investigators report that

this river carries 5,000 parts of solids in suspension per million during midsummer, 200 parts as a minimum during the winter season and has an average throughout the year of from 1200 to 1500. The amount of mud or matter carried in suspension by certain well known rivers has been determined and reported as follows:

Rivers	Parts of Solid Matter Per Million
Thames	30
Rhine	500
Mississippi	1460
Nile	1600
Ganges	1940
Tiber	4560
Hoang-ho	5000

It has been computed that the Ganges, during 122 days of the rainy season carries to sea—a distance of 500 miles—340,000,000 tons of mud; the Thames, a very small river, is said to carry to the sea no less than 450,000 tons of salts in solution per annum. So the combined mud, salts and matter in solution and suspension carried by large rivers annually to the ocean, seem in magnitude to be almost beyond comprehension. We are told that the total denudation of England (or the washing away of the country into the sea by means of its rivers) is one foot for every 3,500 years, the quantity estimated to be passed in a state of solution only, being on the basis of one foot lowering of its surface each 12,000 years.

The amount of solid matter (i. e., matter in

suspension and not in a state of solution) deposited by certain rivers per annum has been computed as:

Thames	1,865,000	Cubic Feet
Danube	67,000,000	“ “
Rhine	600,000,000	“ “
Mississippi	6,000,000,000	“ “
Ganges	6,370,000,000	“ “

The delta of the Mississippi river has an area of 12,300 sq. miles, and a well sunk at New Orleans, 620 ft. deep encountered only an alluvial deposit. The delta of the river Po in Italy has increased its area 198 sq. miles in the last six centuries. The Ganges, 200 miles from its mouth, spreads out forming a mighty delta with the fine silt brought down the Ganges and Brahmapootra rivers; the area is about 60,000 sq. miles and the bottom of the deposit is not reached at 480 ft.

Turbid waters are not an acceptable form of necessary water supply for either domestic or industrial purposes. Fortunately, however, storage or the impounding of water facilitates the settling of matter held in suspension.

The following figures, based on Flad's observations, show the rate of settlement of silt in Mississippi water:

Time of Storage in Hours	Percentage of Suspended Matter Left in Liquid
0	100.
24	5.5
48	3.3
96	3.

Rideal's experiments of "short period" settling of turbid waters gave the following results:

Time of Storage in Hours	Percentage of Suspended Matter left in Liquid	Time of Storage in Hours	Percentage of Suspended Matter left in Liquid
$\frac{1}{2}$	58	6	26
1	37	8	24
2	32	10	22
4	28.5	12	20

As an illustration of the extent of impurities in the river water used as a source of water supply for a large city, the following extract from the 1914 report of the Sewerage and Water Board of New Orleans, La., is given:

“During the year, 8,147 million gallons were treated at the Carrolton plant and 295 million gallons at the Algiers plant. This amount of water carried 21,300 tons of suspended matter, all of which was removed, and 3,800 tons of hardening constituents, about one-half of which was removed. 3,058 tons of lime and 188 tons of sulphate of iron were required to soften and prepare this water for filtration.”

The great advantage of having a constant and liberal water supply, such as is presented by large rivers, is unfortunately overbalanced by the liability to pollution of the river, through sewage and manufacturing waste being discharged into it from the towns, cities and factories that locate themselves upon its banks. The more thickly populated a river basin and the more “developed” or artificial in its use and manipulation a catchment area or watershed becomes, the more contaminated, insalubrious and noxious becomes the water. Rivers as a general rule flowing through any “settled” country are

so polluted that their direct use as sources of potable water is fraught with much danger. Much of the danger to health is avoided by drawing water

*Typhoid Fever Deaths per 100,000*  
1887-1909 Lawrence, Mass.

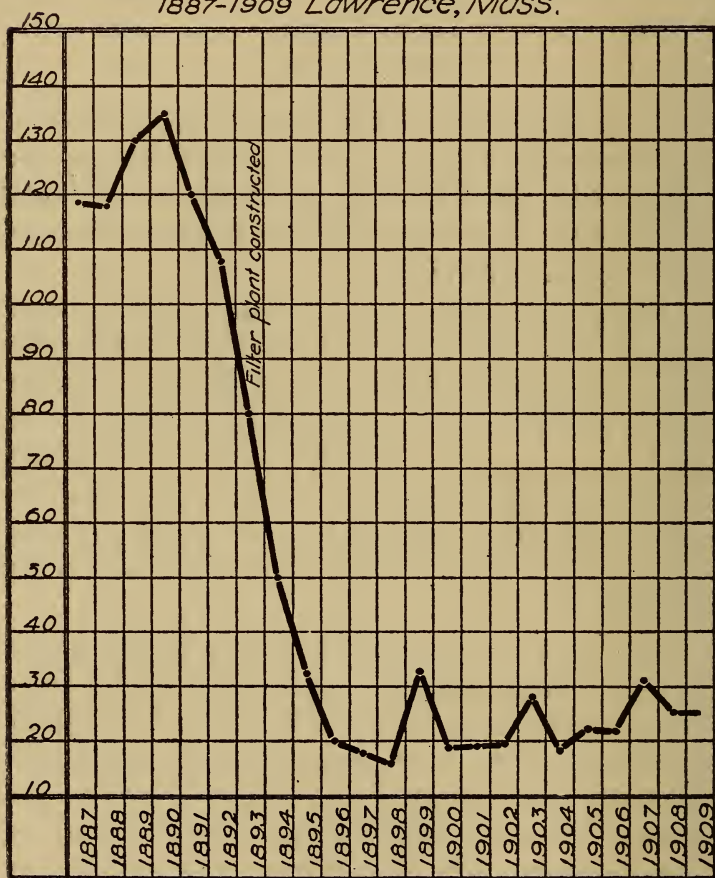


FIG. 6.

from the rivers at points well up the stream and higher than the known point of contamination, discharging such water into impounding reservoirs

and supplying the district in need of water only after the water has had the benefit of storage-sedimentation and natural partial purification. A noted sanitation engineer voiced the sentiment of his profession when he said, however, that "A river or other water once known to have been polluted with sewage (or noxious manufacturing waste) is not fit for drinking purposes without special purification." And again, "From an hygienic standpoint the succession of cities and manufacturing establishments on the same river and the combined use of a river as a sewer and source of water supply is most significant. On some rivers like the Merri-mac, Hudson, Delaware, Ohio, Missouri and Mississippi this succession is particularly impressive and when the water has been used in its raw or unpurified state, sickness and death have resulted and thousands of lives have been lost."

The following large cities in the United States take their water supply from rivers:

City	Population 1910	River	Urban Population per sq. mile of Drainage Area above Intake
Philadelphia	1,550,000	} Delaware	44
St. Louis	687,000		134
Pittsburgh	534,000	Mississippi	8
Cincinnati	364,000	Allegheny	27
New Orleans	339,000	Ohio	32
		Mississippi	10

Among the smaller cities of 100,000 to 250,000 inhabitants we find the urban population per square

mile of drainage or catchment area above the intake of the water supply as follows:

Albany	57
Indianapolis	42
Louisville	36
Paterson	32
Toledo	23

Allen Hazen says, "It is possible to purify sewage before discharging it into rivers. If all the cities and towns purified their sewage, and if all manufacturing establishments (which sometimes contribute as much as the cities to the pollution of the streams) did the same, then the river waters of the country would be less polluted and would be more desirable as sources of public water supply."

\* \* \* "Looking at the whole matter as one great engineering problem, it is clearly and unmistakably better to purify the water supplies taken from the rivers than to purify the sewage before it is discharged into them. It is much cheaper to do it this way. The volume to be handled is less, and, per million gallons, the cost of purifying water is much less than the cost of purifying sewage"—as well as being more effective. Again, *all* and not part would be treated. Hazen also adds, "One dollar spent in purifying the water would do as much good as ten dollars spent in sewage purification."

### Lakes

A lake is a large body of water, not a part of the ocean, contained in a depression of the earth's surface;—it is a natural reservoir. Smaller bodies of water of a similar nature are termed ponds. Lakes may consist of either fresh or salt water, but for our

present purposes, we are only concerned with the former, because of their use in furnishing man occasionally with his required supply of drinking water. Lakes occur in all altitudes and the primary source of lake water is atmospherical precipitation.

The chain of Great Lakes of North America can be briefly dimensioned as follows:

Name	Length in		Depth in ft.		Area in Sq. Miles	Volume in Million Cubic feet
	Miles	Max.	Mean.			
Superior	412	1012	475		31,200	413,000,000
Huron	263	730	250		23,800	166,000,000
Michigan	335	864	325		22,450	203,000,000
Erie	240	210	70		9,960	19,500,000
Ontario	190	738	300		7,240	61,000,000

The water sheds have an area of 202,935 sq. miles land surface and 95,037 sq. miles water surface, or an aggregate of 297,972 sq. miles. The mean elevation above sea level is as follows:

Superior	602 ft.	Erie	573 ft.
Michigan and Huron	581 ft.	Ontario	246 ft.

George R. Whipple, of Harvard University, in a paper read in the early fall of 1912 said: "More than 5,000,000 people live in cities and towns near the shores of our Great Lakes. Most of these communities take their water supplies from the lakes and discharge their sewage into them. Except where the water supply has been purified before being used, this practice has very severely affected the health of the lake cities and has been the cause of much loss of life. With our present sanitary knowledge, it seems strange that such a filthy practice should ever have been tolerated. It is still more strange that raw lake water should continue to be

used in cities which are doing so much in other ways to improve public hygienic conditions."

The pollution of the Great Lakes is greatest at

Cleveland, Ohio, Typhoid Fever Deaths per 100,000 population  
by years, 1873 to 1910

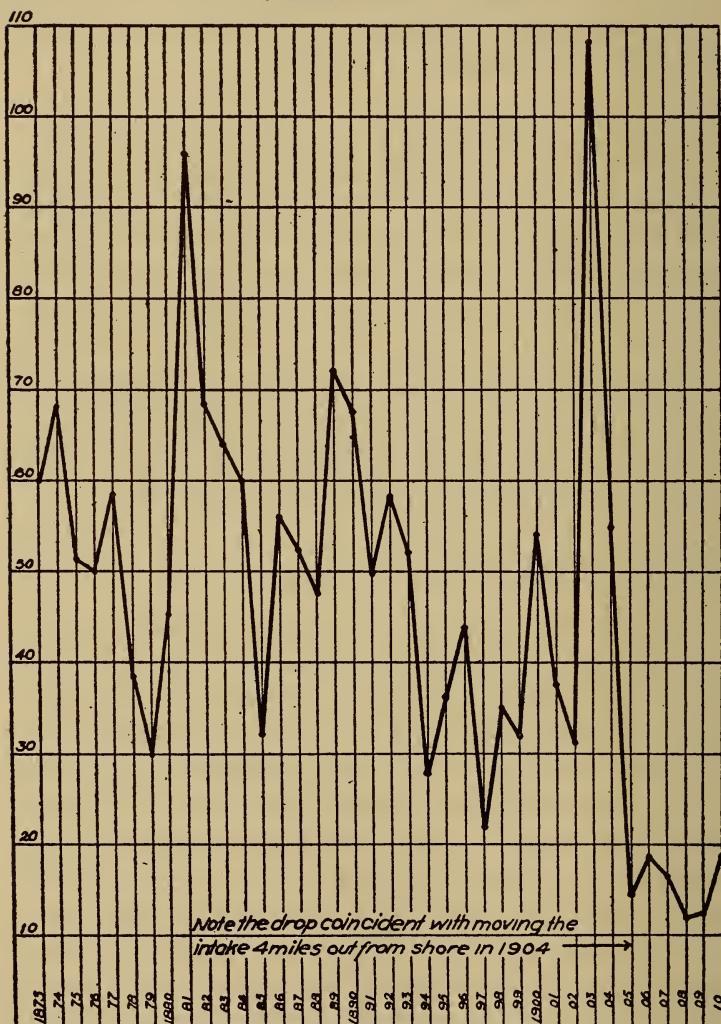


FIG. 7.

the south end of Lake Michigan, where several cities, including Chicago, are comparatively close together and also located on the lake front. The lake water away from the shore, or in the broad waters of the lake, is generally of very good quality; the amount of organic matter is small, the color is low and the water is tasteless, inodorous and comparatively soft, but near the land it is often exceedingly bad.

Barnard and Brewster, at the south end of Lake Michigan, found the following number of bacteria in 1908:

Distance from the shore in miles	Average number of Bacteria per cubic centimetre
0 to 1	174,000
1	15,000
2	6,600
3	5,800
4	4,400
5	1,000
6	200

The following table of solids and the relative hardness of the waters of the Great Lakes may prove of interest:

	Superior	Michigan	Huron	Erie	St. Lawrence at Ogdensburg
Dissolved Solid					
parts per 100,000	8.7	11.8	10.8	13.3	13.4
Total Hardness					
degrees. Clark	3.2	6.9	6.2	7.6	7.5
Permanent Hardness					
degrees. Clark	0.15	0.52	0.45	0.94	0.87

The number of bacteria in the broads of the lakes is almost invariably small; the counts are below 100 per c.c. for the greater part of the year, and in the summer months are much lower. Bacterial life in both salt and fresh water (seas and lakes) decreases in general as one passes downward from the surface and outward from the shore. Drew in 1912 found high numbers of bacteria in surface waters off the Bahamas—13,000 to 16,000—falling off in the cool waters (50° F.) encountered 200 fathoms deep to 17 per c.c. and even less.

Otto and Neumann, in 1904, obtained the following results at various points of the Atlantic Ocean, showing that bacterial numbers decrease as the depth below the surface increases:

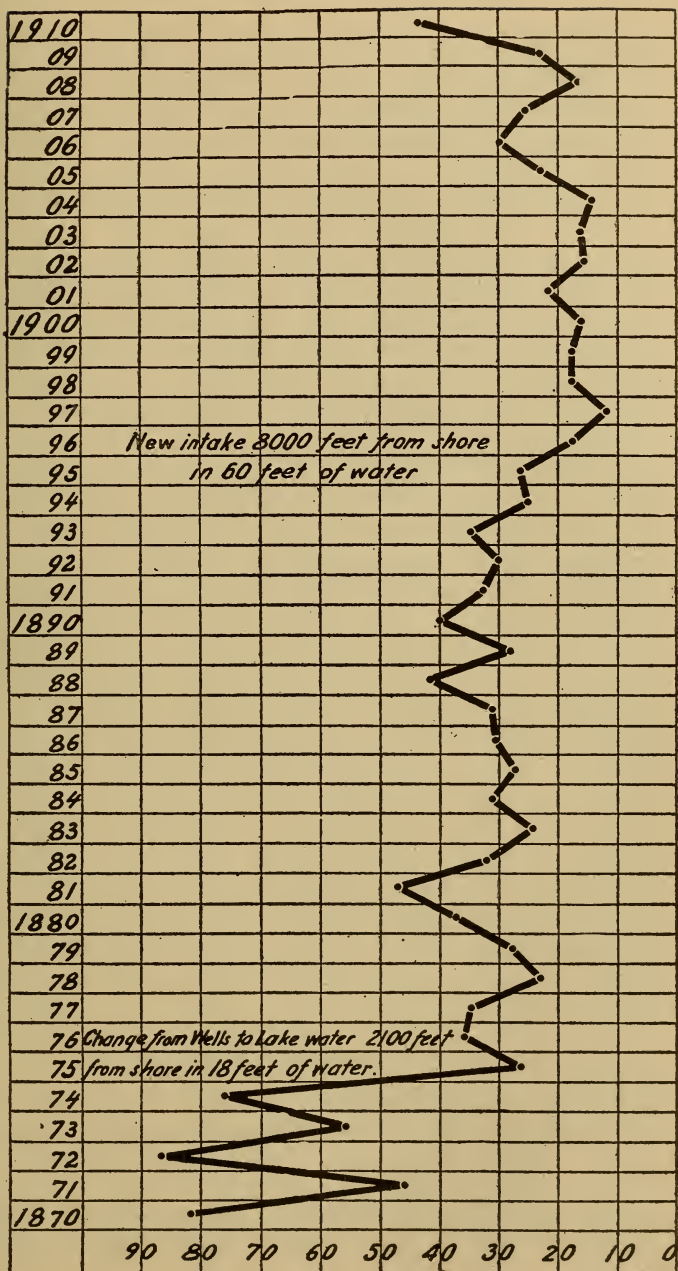
Depth in Meters	Bacteria per C. C.			
	5	50	100	200
Off Canary Islands	120	76	20	1
“ Cape Verde Islands	58	16	64	6
“ St. Paul Islands	20	480	54	4
“ Pernambuco	48	168	83	14

Near the European Coast the bacterial numbers were much higher.

Most of the cities located on the shores of the Great Lakes draw their water from this source. Large cities, such as Chicago and Cleveland, run their intakes as far as 4 or 5 miles into the lake and many of the smaller cities have intakes which project into the lake from 1 to 1½ miles. The depth of the intake straining cribs below the surface is stated as follows:

Oswego	83 ft.	Milwaukee	60 ft.
Toronto	68 ft.	Chicago	27 to 40 ft.

## MORTALITY CHART - TYPHOID FEVER - MILWAUKEE, WIS.



Death Rate per 100,000

FIG. 8.

Chicago and Cleveland have suffered from the mingling of their own sewage with their water supply. Both lakes are comparatively shallow in the vicinity of these cities, and the waters are stirred to their depths by heavy winds fully as far out as the water intakes have been built; Lake Erie, moreover, is very shallow. Both cities have spent millions of dollars driving tunnels out under the bottom of the lakes for the purpose of securing water free from contamination, and Chicago has cut a large drainage canal at a cost of over \$40,000,000 to keep her sewage from entering the lake, taking it instead through tributaries to the Mississippi River. But even now the lake waters are polluted for a long distance out and the putrid refuse and contaminated discharge from a large city is being inflicted upon the inhabitants living on the banks of America's largest and dirtiest river. Chicago's disposition of her sewage problem can hardly be branded as unselfish; the rights of others do not seem to have been seriously considered and the City's Act certainly savors more of arbitrary despotism than altruism. The people should demand sewage and garbage disposal plants and sterilized drinking water and this is procurable and is fully as necessary, if not more so, than other important items of municipal expense for which the citizens are taxed. Both Chicago and Cleveland have failed to obtain thoroughly good wholesome water, and the expenses incurred, without proper filtration and purification or sterilization, have failed to provide a reliable guard against water-borne disease. "Both cities have suffered severely at times, and perhaps a little all the time, from sickness and death caused by the pollution of the Lake water by

their own sewage" and manufacturing waste. In the smaller cities along the Lakes, the mingling of the sewage and water may be relatively just as important as in the large ones. The plan is equally

*Typhoid Fever Death Rates in Chicago, Ill.*  
by years 1881 to 1910



FIG. 9.

vicious. Small cities have generally less money to spend, their intakes do not go out so far and their sewers are apt to discharge at the nearest point, without regard to the location of the fresh water intake.

**The Quantity of Water Consumed by American Cities**

The following table of the amount of water supplied various American cities during some recent years, for which the figures are available, has also been prepared to show the consumption per capita and the general effect of selling water to the consumer by the number of faucets or by quantity determined by meter:

Place	Year	Gallons per capita daily	Percentage of services metered
Buffalo	1912	334	5
Chicago	1911	235	4
Pittsburgh	1910	235	11
Philadelphia	1911	202	4
Detroit	1910	177	10
Washington	1912	175	3
Boston	1912	125	35
Cincinnati	1911	125	48
St. Louis	1911	118	7
Cleveland	1912	113	98
Milwaukee	1912	113	99
Newark	1911	107	54
Louisville	1911	105	7
New York	1912	104	25
Minneapolis	1912	81	59
Worcester	1911	68	97
Hartford,	1911	66	98
Providence	1911	65	89
St. Paul	1911	60	53
Lowell	1912	50	82
Lawrence	1911	46	92
Fall River	1911	44	99

There are 204 cities in the United States having an estimated population in excess of 30,000 and of these, 155 report Municipal ownership of their water supply system. The following table from Government statistics gives the average water consumption of these cities, the amount supplied per

capita and the relation of consumption to the percentage of water metered.

Number of Cities	Water Supplied in Million Gallons Per Year	Population Served	Water Supplied Per Capita (Gallons) Per Day	Percentage of Water Metered
26	56,324	1,805,476	85	100
23	115,822	2,905,871	109	90-99
6	28,286	605,358	128	80-89
13	71,116	1,879,807	103	70-79
14	57,973	1,404,234	113	60-69
13	50,304	1,174,114	117	50-59
9	108,294	2,153,952	138	40-49
15	135,836	2,020,964	184	30-39
15	473,425	9,159,427	142	20-29
8	74,314	866,587	235	10-19
13	157,712	2,216,595	195	0- 9
155	1,329,406	26,192,385	139	

The following table gives the water consumption of the same 155 cities arranged by geographical divisions:

Geographical Division	Number of Cities	Total Quantity of Water Supplied in Million Gallons per Year	Population Served	Water Supplied per Capita (Gallons) per Day
New England	30	96,244	3,103,454	85
Middle Atlantic	32	529,492	10,201,654	142
South Atlantic	14	86,138	1,730,965	136
East-North-Central	32	373,737	6,051,259	169
West-North-Central	14	81,723	1,983,624	113
East-South-Central	9	30,885	778,783	109
West-South-Central	10	26,900	819,378	90
Mountain States	4	15,739	190,380	226
Pacific	10	88,548	1,332,888	182
United States	155	1,329,406	26,192,385	139

America is wasteful, recklessly extravagant in general mode of life and viciously prodigal of her resources. We are both blessed and cursed by living in a wonderful New Land of great bounty and natural wealth. Our fire loss per capita and our water consumption are both suggestive of national carelessness or indifference. The quantities of water supplied per capita in other large cities are included herewith for the purpose of comparison:

Berlin	1909	22 Gallons
Dresden	1909	26 "
Copenhagen	1909	29 "
Amsterdam	1905	37 "
Sydney	1905	39 "
London	1908	41 "
Liverpool	1912	44 "

Many authorities on Hygiene and Sanitation maintain that the health of the individual, family and community demands that the available supply of water, whether urban or rural, should be abundant and convenient. Dr. Bolton of the Department of Agriculture says, "For sanitary purposes it is essential that the water should be in such quantity that there is no need for stinting in any direction. It is essential to have abundance for personal cleanliness, for the laundry, for washing utensils and for the premises generally. It should be abundant at all seasons. The importance of the unrestricted use of water is so great that some hygienists condemn the use of water meters in private houses, in cities with a central water supply, because many people are apt to stint themselves if the water is paid for by the amount used."

There is enough truth in such statements to make them worthy of consideration, but not enough to cause one to modify the statement that Americans are extremely and unnecessarily wasteful in their use of water. Vernon Harcourt says that twenty-five gallons per day is a reasonable average amount of water per person and Dr. Bolton, quoting, apparently concurs. This is about the quantity used in large German cities whose health statistics in many respects are vastly superior to ours. We suffer in America far more from diseases caused by filth and pollution than do the inhabitants of Northern Europe. No one possibly would advocate a water consumption as low as fifteen gallons per person per day, which is said to be the consumption in Vienna, Austria, but there is a great difference between Harcourt's estimate of twenty-five gallons and what is used in the modern healthful cities of Europe on the one hand, as against the American average of one hundred and forty gallons of water per capita for one hundred and fifty-five cities located all over this country.

It is difficult to explain the enormous wastefulness of water in most American cities; the consumption in many cases is so great that pronounced ingenuity in prodigality as well as extreme recklessness must be displayed. Families living in good circumstances in the suburbs, with large gardens to care for, an average of two persons (adults and children) for each bathroom, and all laundry work done upon the premises for two years, averaged without being subjected to any restriction, fifty-seven gallons per person per day. Residents of our cities and all people in poorer circumstances, (urban, suburban and rural) naturally consume

very much less, and it seems reasonable to suppose that an average water consumption for the aggregate population of any large city, including all the water used for normal municipal purposes, should not exceed fifty or sixty gallons per person per day, or less than forty per cent. of that actually reported in 155 of our largest cities and only 16.5% of that reported by our most extravagant and wasteful city.

### **Sedimentation, Sand and Mechanical Filtration**

The water stored in large reservoirs not only parts with much of its silt or solid matter in suspension, but also with the larger portion of its contained bacteria, the majority being carried down apparently by the silt to which they have attached themselves and "the remainder for the most part perishing for lack of adequate food supply and subsequently sinking."

This impounding of water with gravity settling is known as Sedimentation. It is used extensively by British Engineers, some of whom maintain that they have no further need to filter or treat their water, and advise for bacterial safety, reservoirs capable of holding from two weeks to one month's supply of water. The storage for the water of the city of London has increased in capacity 6.3 fold in 24 years. It has been said that the main difference between British and German Sanitary Engineers is that the former rely more upon sedimentation and storage and the latter upon filtration, or some other process. Rideal says, "Neither is reliable unless the 'some other process' consists of real sterilization, which saves storage and simplifies filtration." In the United States the solid matter in water is said to be relatively very slow in depositing, therefore,

sedimentation is assisted by the addition of chemicals which "by coagulation and agglutination of the refractory matter, produces more or less rapid precipitation, and the settling basin with its chemical tank is an almost invariable adjunct to the various types of American Filter plants." Whipple has said that Sand Filters are especially applicable to relatively clear water, and Mechanical Filters to waters that are turbid for a considerable portion of the time and he adds, "In general, practice has followed this classification." The first cost of a Mechanical Filter plant is considerably less than that of Slow Sand and occupies but a fraction of the area, while the operating costs are considerably higher, due largely to the necessity of using a coagulant in the mechanical process. It is said that Sand Beds pass about  $2\frac{1}{2}$  million gallons of water per acre per 24 hours, whereas Mechanical Filters pass 100 million gallons. Mechanical Filtration is the prevalent and popular system in the United States where low cost and quick action are particularly appealing and it is said that 70 per cent. of the water supply of the country is thus purified.

Sand Filtration plants, originally installed to free the water of solid matter held in suspension, soon proved their worth in this direction and, in addition, demonstrated that they operated to reduce the bacterial content of the water. In 1892 Hamburg was visited by a frightful cholera epidemic. Hamburg drew its water from the River Elbe, well above the city, and had no filtration plant. It discharged its sewage into the river and the town of Altona took its drinking water from the Elbe polluted by the great city of Hamburg. Altona used sand filters and their efficiency was clearly

demonstrated when the cholera death rate of Altona was 221 per 100,000, whereas in Hamburg it was 1,250 per 100,000.

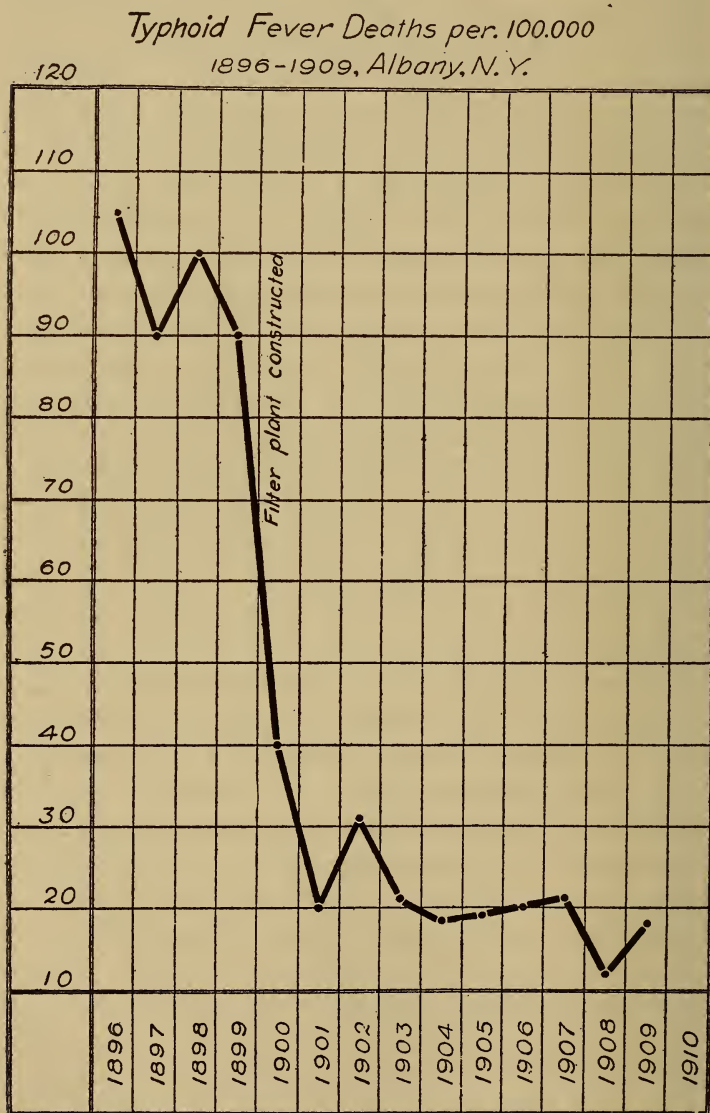


FIG. 10.

At Albany, N. Y., using water from the Hudson River, the Typhoid mortality rate was 88.8 per 100,000 before the introduction of Sand Filters, and 23.7 afterwards. In 1885 Dr. Koch's bacterial water experiments indicated that under the conditions of the tests, the sand filtration process removed 99 per cent. of the total microbes present in unfiltered water.

The London Water Board's Report of 1913 gives the following bacterial content of waters per c.c. before and after sand filtration:

	Thames	Lee	New River
Raw water	5250	9263	2172
Filtered water	16.1	30.9	14.1
Percentage of reduction	99.7	99.6	99.3

The Municipal Filtration Plant in Paris handles 10 million gallons of foul water per day pumped from the Seine. The total time for slow sand filtration treatment is 42 hours, and the following figures show the average results obtained for a period of six months:

Total Bacteria per c.c. after 15 days Incubation			
	Average	Maximum	Minimum
Raw Seine water	53,533	144,300	4,500
Filtered water	33	82	6

The Magdeburg Municipal Laboratory testing the turbid and highly polluted water of the River Elbe before and after sand filtration, gives the following average bacterial results for a month (Nov., 1910):

Total Bacteria per c.c. after 48 hrs. Incubation			
	Average	Maximum	Minimum
Raw Elbe water	43,523	144,000	4,200
Filtered water	5.65	18.	1

Mechanical Filters are popularly known as the "Rapid" or American type. The slow sand filters owe their bacterial reducing efficiency to the formation of a film of living growth and the first part of the sand impregnated with bacterial life, purifies the water passing through. A new clean sand filter is not efficient from the standpoint of water purification. Mechanical Filters might fittingly be termed "Inorganic" filters, and Slow Sand Filters "Organic" filters, Mechanical Filtration using an artificial film formed with inorganic colloids. A coagulating chemical is required by the Mechanical Filtration process; the gelatinous precipitates of such substances, for instance hydrated alumina, draws down with it the colloidal albuminoid putrescible matter, as well as up to 98 per cent., or even more, of the bacteria, in addition to the suspended matter.

Lake Erie water at Lorain, tested in 1897, before and after passing through filters in which Aluminum Sulphate was used, gave the following results:

Raw water	507 Bacteria per c.c.
Filtered water	14      "      "      "
Percentage reduction	96.4

The reports gathered from 18 large cities and towns in the United States using Mechanical Filters and Sulphate of Alumina (Alum) as a coagulant gave an average reduction of the bacterial content of water of 98.57 per cent., due to the use of such Water Purification Plants.

Pittsburgh, removing 95 per cent. of the bacteria present in her water, used .7 grams of Aluminum Sulphate per gallon as the coagulant. The relation

of chemicals used to purification obtained was as follows:

Grams of Aluminum Sulphate  
per gallon of water

.7	.98
.72	1.22
.78	1.66

Bacterial reduction  
obtained per cent

95	98
96	98.5
97	99

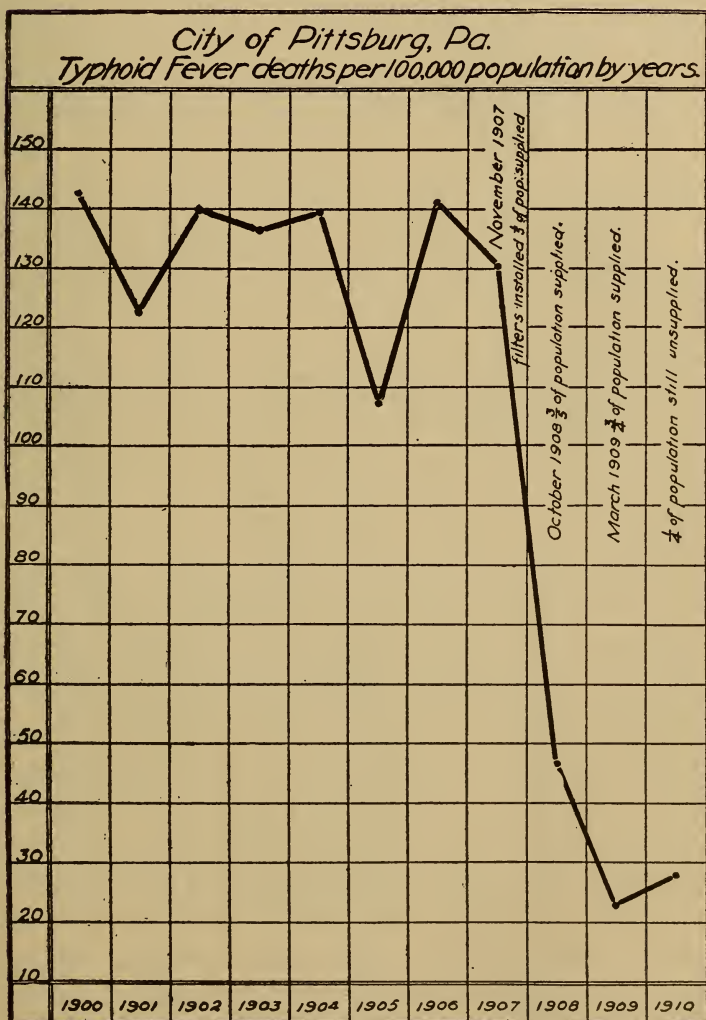


FIG. 11.

Elmira, N. Y., using 1.38 grs. of Alum per gallon of water, removed 98.43 per cent. of the bacteria, and East Providence using 1 grain per gallon, removed 99.24 per cent.

The following table has been prepared from the New York State published Health Records:

Place	Water Purification Plant	Average Typhoid Mortality <i>before</i> Purification Plant in use	Average Typhoid Mortality <i>after</i> Purification Plant in use	Per cent. Reduction in Death Rate
Albany	Slow Sand Filters	88.8	23.7	73.0
Binghamton	Gravity Mechanical Filters	39.3	11.7	72.2
Elmira	Gravity Mechanical Filters	54.9	41.5	24.4
Hornell	Hor. Pressure Mechanical Filters	42.2	24.7	41.4
Hudson	Purer Source & Modern Filter Plant	64.3	31.9	50.5
Ithaca	Part wells and springs, Part Gravity Mechanical Filters	67.2	14.6	78.3
Rensselaer	Gravity Mechanical Filters	95.5	54.4	43.0
Schenectady	Wells or Infiltration Galleries	25.0	14.4	42.6
Troy	Surface Gravity instead of Hudson River	58.2	31.0	42.6
Watertown	Gravity Mechanical Filters	94.7	36.9	61.8

Aluminum Sulphate, the popular coagulant used, should never be purchased and used in water purification plants, without being subjected to thorough analysis. The pure salt has no physiological action beyond astringency, therefore, an accidental excess of the pure salt would be generally harmless, although it should, of course, be avoided. Aluminum Sulphate solution is naturally acid, but in the commercial article, besides a variable amount of water by hydration, there is sometimes an objectionable excess of Sulphuric Acid and also other impurities, even arsenic.

Mechanical filtration cannot be used successfully for very soft water, without subjecting the water to auxiliary chemical treatment, for there may not be sufficient earthy carbonate in the natural water to precipitate the reagent, and more lime or chalk has to be added. Aluminum Sulphate works by reacting with the carbonate of lime and magnesia in water, when, as Aluminum forms no carbonate, hydrated alumina is separated in the gelatinous form that entangles impurities, and Sulphate of Lime or Magnesia is left in solution; temporary hardness is thus changed into permanent hardness.

The Mechanical filter operates with an inorganic film, which is very strong and tenacious and capable of standing a good head of water. The film when old has to be cleaned and washed out with its supporting medium and a fresh supply of the coagulant added, about ten minutes being generally required for the operation. Accompanying curve, with descriptive matter, for which we are indebted to Rideal, illustrates the working of a mechanical filter as regards time-reduction in number of bacteria

It will be noticed that this proceeds rapidly during the first minute, then more slowly, until after ten minutes it reaches 85 per cent. with a gradual increase of efficiency afterwards.

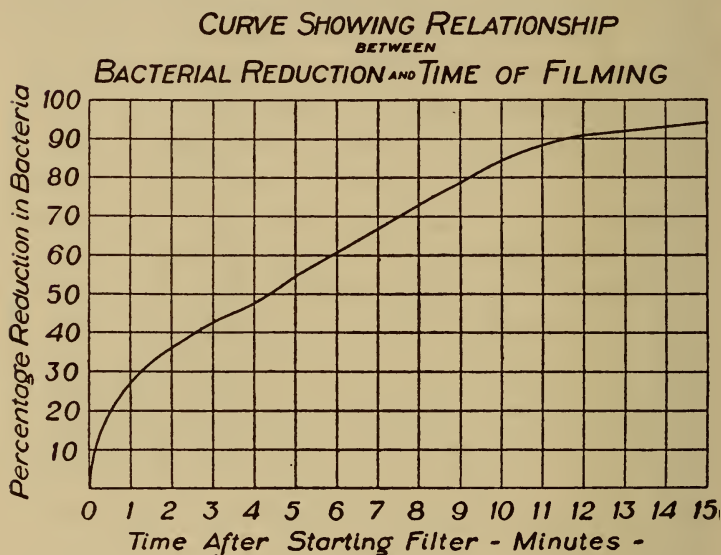


FIG. 12.

The quantity of water that has to be wasted in washing out the old film and in forming the new one has varied, according to Rideal, between 2.5 and 5 per cent. of the total amount of water passed. The washing is usually done by reversing the flow and sometimes injecting steam, and occasionally soda, and in very muddy waters may be even required two or three times a day. Mechanical Filters are of the open "Gravity" type and the "Pressure" or closed type; the "Gravity" type generally gives a better standard of purification and is the one in general public use.

**Water Purification**

The processes of Water Purification may be briefly classified as suggested by Allen Hazen as follows:

**I. *Mechanical Separation.***

By Gravity	Sedimentation.
By Screening	Screens, Scrubbers, Filters.
By Adhesion	Scrubbers, Filters.

**II. *Coagulation.***

By chemical treatment resulting in drawing matters together into groups, thereby making them more susceptible to removal by mechanical separation, but without any significant chemical change in the water.

**III. *Chemical Purification.***

Softening—by the use of Lime, etc.

Iron removal.

Neutralization of objectionable acids, etc.

**IV. *Disinfecting Processes.***

Hypochlorite of Lime

Chlorine Gas

Ozone

Sulphate of Copper

Violet Ray Treatment.

The object of these processes is to poison and kill objectionable organisms without at the same time adding substances objectionable or poisonous to the users of the water.

**V. *Biological Process.***

Oxidation of organic matter by its use as food for organisms which thereby effect its destruction. Death of objectionable organisms resulting from the production of unfavorable conditions, such as absence of food (removed by the purification processes), killing by antagonistic organisms, etc.

VI. *Aeration.*

Evaporation of gases held in solution and which are the cause of objectionable tastes and odors. Evaporation of Carbonic Acid, a food supply for some kinds of growth.

Supplying oxygen necessary for certain chemical purification and especially necessary to support growths of water purifying organisms.

VII. *Boiling.*

The best household method of protection from disease-carrying waters.

Sometimes two processes are combined, as where river water is softened by chemical treatment in such a way as to produce a coagulating effect upon the suspended matters.

Many of the disinfectants are powerful oxidizing agents. Hypochlorite of Lime, Liquid Chlorine and Ozone are among the most powerful oxidizing agents known. In addition to killing the objectionable organisms, there is sure to be direct chemical action resulting from these substances, which tends to the purification of the water and at the same time to the destruction and elimination of the applied substances from the water. These secondary actions are often of great importance.

Ozone, or the Ultra Violet Ray, should not be used for turbid and polluted water purification, unless the water is first cleansed of the matter carried in suspension. Hazen says, "If Ozone is applied to dirty water in quantity sufficient to kill the objectionable organisms in clear water, it may happen that the impurities in the water will absorb and use up the Ozone so rapidly that it will not have

a chance to act upon the organisms and the desired effect will not be produced. For this and other reasons, it is not advisable to apply such oxidizing agents to dirty raw water."

Foreign inorganic matter in the thin film of water passing the Ultra Violet Ray Lamp will furnish a hiding place and refuge for bacterial life from the actinic rays of light and thus rob the system of its destroying power.

We are informed that the Hypochlorite of Lime is practically equivalent in disinfecting power to Ozone, on the basis of molecule for molecule of effective oxidizing material. Hypochlorite of Lime has produced gratifying results in water purification by the disinfecting process, at a cost said to be so low that it could be employed economically in any Public Water Works plant, where its use would be considered necessary or desirable. Authorities say that the cost of material needed in the chemical disinfecting process is not more than 15 to 25 cents per million gallons, and the entire cost of treatment is not more than one-tenth the cost of filtration.

Liquid Chlorine is now being used extensively as a substitute for Hypochlorite of Lime. The active agent is the same and "it may be assumed that corresponding quantities, molecule for molecule of active material, will be required." The use of Chlorine is in many respects more convenient than the use of Hypochlorite of Lime, but it is generally more expensive. Chlorine is supplied in cylinders under heavy pressure, and at this time, because of the European war, the price is unusually high and the quantity available for domestic consumption small.

**Purification by Ultra Violet Rays**

Scientists have long known that strong sunlight has the power of purifying water by killing the organisms and bacteria therein. Experiments have proved that the inhibitive property of direct sunlight may penetrate into bodies of water for several feet, its power being felt in clear water to a depth of 6 or even 8 feet. In turbid water it is soon arrested and the effect of strong sunlight upon bacteria in water depends upon the clearness of the water and its depth. Shallow clear water may be very materially benefited and purified by strong sunlight, although such light may detrimentally affect the water in a far less harmful way by encouraging the growth of Green Algae. The growth of Green Algae in storage waters can be prevented by excluding light, hence many storage reservoirs are covered over, but on the other hand the beneficial effect of light in destroying the micro-organisms of disease is hindered or lost; the Algae are infinitely less dangerous than the pathogenic bacteria. It is only comparatively recently that the germicidal power of certain rays, invisible to the human eye, has become known and the knowledge made of practical value in the purification of water, without the use of chemicals and the resultant production of disagreeable tastes and odors. Dieudonné worked out the difference in action between the rays of different wave-lengths in the spectrum; those of the longest wave-length and slowest vibration at the red end, the "heat rays," had no germicidal power; this began at the yellow "light rays" when the vibration-velocity of the ray was greater and its wave-length consequently shorter. The changes correspondingly

progress through the green, blue and violet, the "chemical or actinic" rays increasing in germicidal power. The invisible or obscure rays beyond the violet, known as the "Ultra Violet" possessed still greater germicidal properties. In order to produce Ultra Violet Rays in a practical and economical manner for commercial use, a source other than the rays from sunlight had to be found and the mercury vapor arc, contained in a rock crystal quartz lamp, is now used with success in the production of Ultra Violet Rays in a concentrated and usable form.

This type of water purifier was first used in France where several Municipal supplies have been treated by sand filtration and Ultra Violet Rays. At Lunéville, France, about two million gallons of water per day are being successfully treated by this method and the following table of number of bacteria per c.c. records the practical benefit of the Ultra Violet Ray plant in the reduction of bacterial content.

Year	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1908	15	6	121	20
1909	57	12	7	55
1910	19	3	5	46
1911	69	5	32	10
1912	14	11	9*	2
1912	2	5	3	2

\*The Ultra Violet Ray plant commenced operations during latter part of August, 1912; before that time the Sand Filtration plant only was in use.

Since the installation of the Ultra Violet Ray plant it is said that no disease producing bacteria nor coli-bacillus have been found in the water.

All water to be treated by Ultra Violet Rays must be free from suspended matter and colors. Light rays cannot remove them. The natural taste, beneficial sources and gases of the water are not changed and as the rays of light can carry no contamination, nothing is put into the water during the process. To remove all suspended matter, Slow Sand or Mechanical Filters should be used. An Ultra Violet Ray Water Purification Process to be effective must compel all the water to be treated to come into close contact with the electrically operated quartz lamps. Usually the water is forced to pass within about  $1\frac{1}{2}$  inches of the lamps, and by means of baffle plates the water is caused to pass the light in such a way that it receives the rays of light from every angle, as well as coming into intimate contact with them.

The U. S. Public Health Service at Marine Hospital, Chicago, has made exhaustive tests on Ultra Violet Ray Water Purifiers, which clearly demonstrate their efficiency; and the Detroit Testing Laboratory reported effective results obtained in October, 1915. The Parke-Davis Co. tests, conducted in April, 1914, gave the following results:

Inflowing water	330,000	bacteria	per	c.c.
Outflowing water (after 3 min.)	470	"	"	"
Outflowing water (after 5 min.)	110	"	"	"
Reduction of bacteria	99.96%			

The conditions of this test were made unusually severe by artificial pollution, and under ordinary conditions the number of organisms in the inflowing water would not exceed 500 bacteria per c.c.

Tests made with similar apparatus at Binghamton, N. Y., during November, 1914, have been reported as follows:

	Raw water with sewage	Treated water
Bacteria per c.c. at blood heat	3,600	0
Acid formers	320	0
Gas formation	present	0

The Steuben Laboratory, of Corning, N. Y., has made exhaustive tests of which the following is a brief digest:

	Raw Imp. Basin	Treated Imp. Basin
A.		
Bacteria at blood heat	52	Sterile
Gas formation	present	0
Subculture positive for B. Coli in raw sample.		
B.	B. Coli Raw	B. Coli Treated
Bacteria at blood heat	10,000 estimated	Sterile
Gas formation	present	0
Subcultures positive for B. Coli in raw sample.		
	Typhoid Raw	Typhoid Treated
C.		
Bacteria at blood heat	10,000 estimated	8
Gas formation	present	0
Sample contaminated with mixture B. Typhosus and B. Coli.		
Subculture from treated water shows no evidence of B. Coli nor B. Typhosus.		
Eight colonies seemed to be Staphylococci.		
D.	Sewage	Sewage Treated
Bacteria at blood heat	43	1
Gas formation	present	0
Subculture positive for B. Coli in raw sample.		

Ultra Violet Ray Water Purifiers afford a handy means of treating water in either small or large quantities. They are being used to-day to cleanse the water of swimming pools and also the water used by industrial establishments; The Diamond

Match Co. has treated the drinking water in its Barberton, Ohio, Factory by this process since 1914 as a safeguard against the possible contamination of the well water used.

The Barberton R. U. V. Sterilizer is placed within a screened enclosure at the end of the employees dining room and is thoroughly open to view. It is marked "Employees Drinking Water Purification Plant" and is provided with glass plates which enable one to clearly see by the conspicuous violet light if the sterilizing action is taking place. The Barberton apparatus consists of a single casting about three feet in diameter with a ray-producing burner inserted in the center. The sterilizer operates on 220 volts D. C. and has a capacity of one thousand gallons per hour.

### **Aeration**

The simplest, cheapest and most generally applicable method of removing tastes and odors from water is by aeration, i. e., bringing the water in contact with air by playing the water into it by fountains or by water falls. The natural flow of water in the bed of a mountain stream over stones and ledges aerates it very well. A water to be palatable should be fully aerated, i. e., it should be nearly saturated with the natural constituents of the atmosphere, viz.: Oxygen, Nitrogen and Carbonic Acid; otherwise the liquid is flat and insipid.

### **Sterilization of Water**

To sterilize water requires that it be made absolutely free from all reproductive spores, germs, or bacilli, and there is no safe method of preventing water-borne disease except by sterilization of the liquid. Water Purifying Systems have been

termed Sterilizing Plants and in many cases the difference between an acknowledged "Purification" Plant and a supposititious "Sterilization" Plant is solely one of extent or degree of treatment, where the process causes a reduction of bacterial life varying with the thoroughness of the attempt made to destroy organic life, but which cannot possibly function so as to absolutely guarantee the elimination of *all* reproductive spores and bacilli.

In sedimentation, with or without coagulants, a remarkable purification of the water is effected in regard not only to matter in suspension, but also to organisms. Sedimentation followed by Slow Sand, or "Rapid" Mechanical Filtration can, under the best conditions, maintain a reduction in the number of bacteria per unit volume of water up to about 98 per cent. Winslow says that water very heavily polluted with sewage cannot be made positively wholesome and potable by Chlorine or Hypochlorite treatment any more than by filtration. He maintains that disinfection of water with bleaching powder and kindred chemicals is best as a double safeguard in connection with some other efficient and recognized water purification process. "Taking an ordinary polluted stream as the original source of most water supplies, there are now three processes by which it can be treated, viz.: Storage, Filtration and Disinfection. A fairly well stored water, which is generally pretty safe but not always quite safe, can be rendered unexceptionable by Chlorine (disinfection) treatment. Where a surface water is not stored, but filtered, disinfection again affords a double safeguard. Filtration alone will remove from 95 to 98 per cent. of bacterial contamination in well built and efficiently operated

Water Purification Plants; Hypochlorates, in conjunction with filtration, will still further destroy bacterial life, increasing the total destruction of organic life to 98, 99 and possibly under certain conditions, even 100 per cent. of the content of the original raw water." In Omaha, Nebraska, the Typhoid death rate was 67 per 100,000 with filtered water, and this was reduced to 12 per 100,000 when a chemical Disinfecting Plant was operated as an adjunct to the Filtration Plant. In Minneapolis, the Typhoid rate of 58.7 was reduced 95 per cent. by the addition of the Hypochlorate plant worked in conjunction with the filtration system. The number of Typhoid deaths in Pittsburgh was reduced from 141 in 1906 to 10 in 1911 by the use, as an additional safeguard, of "disinfecting" chemicals in conjunction with a filtration plant.

The Sterilization of water requires the destruction of all bacteria, which will insure the killing of all pathogenic organisms and not the mere temporary reduction of their numbers or sifting some of them out. Many bacilli are harmless but certain pathogenic germs are the carriers of baneful diseases; they multiply with amazing activity in a suitable environment—Cramer, of Zurich, found that bacteria in a specimen of city water increased 27,000 times in a few days—and a few, slipping by the defenses of a water purification plant, have proven their ability in the past to cause an epidemic in a community fed with a common water supply and served by a common sewage system. Our unnatural mode of living under the artificial conditions caused and demanded by "civilization," and our crudeness in expressing an attitude of insurgency against nature's laws by neglecting to pro-

tect ourselves from inevitable dangers which are invited by our foolhardy and blundering steps in defiance of geological and biological laws, is symbolic of the egotism of a species intoxicated with power and freedom which is just emerging into a domain of apparently unrestricted liberty. It is a truism that the Price of Health—of life lived under unnatural and artificial surroundings—is Eternal Vigilance. We contaminate nature's laws and pollute her waters; we should, therefore, be as aggressive in our defense of our position as we are in our attack on nature and refuse to be satisfied with "comparatively wholesome" water. If we would systematically and definitely bar disease from entering our system through the channel of our drinking water supply, we would see that such water is sterilized; no other procedure will give us the security that our vulnerable position demands. We are polluters, as well as users and manipulators of the surface of the earth, and even nature's geological filters may have fissures or channels through which water can pass from the surface freely to subterranean water courses, thus feeding to man from deep wells, water but little better than unpurified surface water. The adoption of pure and reliable water supplies by our cities and towns is generally defeated or postponed by ignorance, indifference, fatalism or the question of expense. We also frequently hear that the inhabitants of any district gradually become accustomed to the deleterious action of bacteria peculiar to the waters. The resistance of the human system is a very variable quantity; it is always liable to break down. Health cannot be measured in monetary terms, but history, if studied, will teach us that epidemics have been

enormously expensive in the past in a pecuniary sense as well as in lives, well-being and happiness, and smaller epidemics are prevalent to-day and still continue to be costly. Hazen first noticed that where one death from typhoid has been avoided by the use of better and more wholesome water, a certain number of deaths, probably two or three from other causes, seem also to have been avoided. Sedgwick and McNutt have elaborated this thought and fully established the fact that where purer water is supplied the general death rate declines more rapidly than the typhoid death rate.

Nearly all bacteria thrive best in neutral or slightly alkaline solutions and decline in acid ones. During the South African war, tablets of Acid Sodium Sulphate used in the proportion of 15 grains per pint of water were used with success to purify the water. Citric acid in the proportion of 8 to 10,000 is said to prove fatal to Cholera Bacilli, and in the proportion of 10 to 10,000 destroys typhoid bacilli.

Magnesium peroxide is now much used to "sterilize" bottled mineral waters. It does not seem to unpleasantly affect the taste and in small quantities is physiologically harmless; the usual quantity employed is 1 gr. per litre. Excess lime or the liberal use of Chlorine or Hypochlorates have been claimed to produce sterilization of water. Adding chemicals to water is not generally advisable in private houses, since a slight excess may yield a solution strong enough to have toxic properties; the use of chemicals in tablet form has been suggested and may, to a certain extent, overcome the objection, but the use of tablets requires an accurate measuring of the water, which cannot always be re-

lied upon in the average household. In houses equipped with electric light, small automatic installations for sterilizing water by means of Ozone, Ultra Violet Rays or Electrolytic Sodium Hypochlorate can be used, but such systems demand that the water to be treated shall first have been freed from suspended matter. Ozonators require the use of dry air, and with such a plant it is generally necessary to pass the air through dehydrating chemicals, such as Calcium Chloride, before the Ozone can be effectively produced for use in the purification of water. The chemicals are, of course, not brought into contact with water and the great advantage of Light Rays and Ozone in the purification of water, lies in the fact that they do not add foreign matter of any kind to the water. Ozone plants are installed for the sterilization of water in Paris, Nice and Petrograd and they are now being exploited in our own country.

In addition to the possibility of sterilizing water by Ultra Violet Rays, Ozone and chemicals, when used in conjunction with Filtration plants, sterilization can also be obtained by heating; apparatus has been built to permit of the sterilization of water fairly economically by heating at a temperature in excess of  $212^{\circ}$  F. for a period of 10 minutes or more, the temperature and time being such as will positively kill the spores of all organisms, including those which are comparatively resistant to heat.

To sterilize water in a definite and positive manner is an expensive operation, and persistent records need to be taken and untiring watchfulness manifested if such sterilization is to be effective and maintained throughout all the hours of the day and the days of the year. Methods which attempt



MUNICIPALLY OWNED WATER SUPPLY SYSTEMS OF AMERICAN CITIES OF OVER 30,000 INHABITANTS.  
(From the General Statistics of Cities, 1915; U. S. Department of Commerce.)

DIFFERENT PURIFICATION PROCESSES NOW IN USE.

YEAR INSTALLED.	Sedimentation.	Coagulation.	Slow sand filtration.	Mechanical filtration.	Chemical sterilization.
1853.	Washington, D. C.				
1879.	Louisville, Ky.				
1883.	Council Bluffs, Iowa.				
1889.	Dallas, Tex.				
1890.	Omaha, Nebr.	Omaha, Nebr.		Oskosh, Wis.	
1890.	Oshkosh, Wis.				
1892.	Atlanta, Ga.				
1893.					
1894.	Knoxville, Tenn.	Knoxville, Tenn.	Lawrence, Mass.		
1894.			Altoona, Pa.		
1896.			Knoxville, Tenn.		
1896.		Cedar Rapids, Iowa.		Charlotte, N. C.	
1896.				Cedar Rapids, Iowa.	
1898.	Macon, Ga.		Augusta, Ga.		
1898.			Macon, Ga.		
1899.	Albany, N. Y.		Albany, N. Y.	Norfolk, Va.	
1900.	Kansas City, Mo.	Kansas City, Mo.			
1902.	Philadelphia, Pa.		Philadelphia, Pa.		Mobile, Ala.
1902.			Birmingham, N. Y.		
1902.			Providence, R. I.		
1902.			Austin, Tex.		
1903.			Washington, D. C.	New York, N. Y.	
1903.			Reading, Pa.		
1903.			Yonkers, N. Y.		
1904.	St. Louis, Mo.	St. Louis, Mo.		Knoxville, Tenn.	
1904.		Atlanta, Ga.			
1905.	Youngstown, Ohio.	Harrisburg, Pa.		Youngstown, Ohio.	Harrisburg, Pa.
1905.	Wilmington, Del.	Charlotte, N. C.		Harrisburg, Pa.	
1905.	Harrisburg, Pa.	Columbia, S. C.		Columbia, S. C.	
1905.	Columbia, S. C.				
1906.			New York, N. Y.		
1907.	Oklahoma City, Okla.	Lorain, Ohio.		San Diego, Cal.	
1907.				Lorain, Ohio.	
1908.	Pittsburgh, Pa.	Cincinnati, Ohio.	Pittsburgh, Pa.	Cincinnati, Ohio.	Jersey City, N. J.
1908.	Cincinnati, Ohio.	New Orleans, La.	Wilmington, Del.	New Orleans, La.	Columbus, Ohio.
1908.	New Orleans, La.			Columbus, Ohio.	Omaha, Nebr.
1908.	Nashville, Tenn.			McKeesport, Pa.	Charlotte, N. C.
1908.	McKeesport, Pa.				
1909.	Richmond, Va.	Louisville, Ky.	Kansas City, Kans.	Louisville, Ky.	Nashville, Tenn.
1909.	Kansas City, Kans.	Richmond, Va.		Albany, N. Y.	Kansas City, Kans.
1909.		Nashville, Tenn.		Kansas City, Kans.	
1909.		Kansas City, Kans.			
1910.	Springfield, Mass.	Washington, D. C.	Springfield, Mass.	Toledo, Ohio.	Pittsburgh, Pa.
1910.	Pueblo, Colo.	Springfield, Mass.		Atlanta, Ga.	Milwaukee, Wis.
1910.		Pueblo, Colo.			Lima, Ohio.
1910.		Council Bluffs, Iowa.			Council Bluffs, Iowa.
1911.		Niagara Falls, N. Y.		Montgomery, Ala.	Cincinnati, Ohio.
1911.				Niagara Falls, N. Y.	Kansas City, Mo.
1911.					Trenton, N. J.
1911.					Albany, N. Y.
1911.					Lincoln, Nebr.
1911.					
1911.	Flint, Mich.	Evansville, Ind.			Muskogee, Okla.
1912.	Newport, Ky.			Grand Rapids, Mich.	Niagara Falls, N. Y.
1912.				Fort Worth, Tex.	New York, N. Y.
1912.				Evansville, Ind.	Chicago, Ill.
1912.					St. Louis, Mo.
1912.				Flint, Mich.	Detroit, Mich.
1912.					Tacoma, Wash.
1912.					Wilmington, Del.
1912.					Evansville, Ind.
1912.					Flint, Mich.
1912.					
1912.	Minneapolis, Minn.			Minneapolis, Minn.	Cedar Rapids, Iowa.
1913.					Philadelphia, Pa.
1913.					Cleveland, Ohio.
1913.					Louisville, Ky.
1913.					
1913.					Hartford, Conn.
1913.					Duluth, Minn.
1913.					Portland, Me.
1913.					Auburn, N. Y.
1913.					
1913.					Lynchburg, Va.
1914.	Trenton, N. J.	Dallas, Tex.		Baltimore, Md.	Buffalo, N. Y.
1914.	Decatur, Ill.	Trenton, N. J.		Dallas, Tex.	Dallas, Tex.
1914.		Albany, N. Y.		Trenton, N. J.	Bay City, Mich.
1914.					
1914.		Decatur, Ill.		Erie, Pa.	Decatur, Ill.
1914.				Decatur, Ill.	Columbia, S. C.
1914.				Waco, Tex.	
1915.				St. Louis, Mo.	

CITY.	Cost per million gallons.	Processes employed. <sup>1</sup>	CITY.	Cost per million gallons.	Processes employed. <sup>1</sup>
Cities employing five processes:					
Albany, N. Y.	\$7.75	a, b, c, d, e.	Baltimore, Md.	\$1.06	d, e.
Kansas City, Kans.	4.08	a, b, c, d, e.	Columbus, Ohio.	17.46	d, e.
Cities employing four processes:					
Knoxville, Tenn.	12.59	a, b, c, d.	Cities employing one process:		
St. Louis, Mo.	4.56	a, b, d, e.	Oklahoma City, Okla.	1.90	a.
Cincinnati, Ohio.	3.57	a, b, d, e.	Newport, Ky.	2.44	a.
Louisville, Ky.	3.54	a, b, d, e.	Providence, R. I.	4.86	c.
Dallas, Tex.	8.07	a, b, d, e.	Reading, Pa.	1.50	c.
Trenton, N. J.	3.00	a, b, d, e.	Lawrence, Mass.	4.62	c.
Harrisburg, Pa.	6.10	a, b, d, e.	Yonkers, N. Y.	3.48	c.
Decatur, Ill.	2.65	a, b, d, e.	Altoona, Pa.	( <sup>2</sup> )	c.
Columbia, S. C.	8.03	a, b, d, e.	Augusta, Ga.	( <sup>2</sup> )	c.
Philadelphia, Pa.	0.22	a, c, d, e.	Augusta, Ga.	( <sup>2</sup> )	c.
Cities employing three processes:					
Washington, D. C.	1.68	a, b, c.	Toledo, Ohio.	5.57	d.
Springfield, Mass.	4.38	a, b, c.	Grand Rapids, Mich.	11.31	d.
New Orleans, La.	5.49	a, b, d.	Fort Worth, Tex.	9.35	d.
Atlanta, Ga.	2.10	a, b, d.	Norfolk, Va.	5.36	d.
Kansas City, Mo.	2.69	a, b, e.	Erie, Pa.	1.72	d.
Omaha, Nebr.	4.00	a, b, e.	Binghamton, N. Y.	5.00	d.
Nashville, Tenn.	2.84	a, b, e.	San Diego, Cal.	( <sup>2</sup> )	d.
Council Bluffs, Iowa.	4.62	a, b, e.	Montgomery, Ala.	( <sup>2</sup> )	d.
Pittsburgh, Pa.	2.34	a, c, e.	Waco, Tex.	5.00	d.
Wilmington, Del.	1.34	a, c, e.	Waco, Tex.	0.04	e.
Flint, Mich.	2.50	a, d, e.	Chicago, Ill.	0.19	e.
Evansville, Ind.	2.48	a, d, e.	Cleveland, Ohio.	0.12	e.
Charlotte, N. C.	10.42	b, d, e.	Detroit, Mich.	0.16	e.
Cedar Rapids, Iowa.	10.00	b, d, e.	Buffalo, N. Y.	0.20	e.
Niagara Falls, N. Y.	0.289	b, d, e.	Milwaukee, Wis.	0.07	e.
New York, N. Y.	( <sup>2</sup> )	c, d, e.	Jersey City, N. J.	1.00	e.
Cities employing two processes:					
Richmond, Va.	5.60	a, b.	Hartford, Conn.	0.20	e.
Pueblo, Colo.	4.45	a, b.	Tacoma, Wash.	0.12	e.
Macon, Ga.	2.00	a, c.	Duluth, Minn.	0.12	e.
Minneapolis, Minn.	9.18	a, c.	Portland, Me.	0.27	e.
Youngstown, Ohio.	2.40	a, d.	Mobile, Ala.	0.30	e.
McKeesport, Pa.	( <sup>2</sup> )	a, d.	Bay City, Mich.	0.60	e.
Oshkosh, Wis.	4.25	a, d.	Lincoln, Nebr.	0.60	e.
Lorain, Ohio.	11.45	b, d.	Muskogee, Okla.	1.50	e.
			Auburn, N. Y.	0.25	e.
			Lima, Ohio.	0.68	e.
			Lynchburg, Va.	1.00	e.

<sup>1</sup> a, sedimentation; b, coagulation; c, slow sand filtration; d, mechanical filtration; e, chemical sterilization.

<sup>2</sup> Cost not comparable.

<sup>3</sup> Not reported.

sterilization of water are more costly per unit of organic matter dealt with than Sedimentation or Filtration processes; therefore, it is more economical to remove as much deleterious matter and organisms as possible by prefiltration and pre-sedimentation, reserving the final sterilization process for the odd 2 per cent. of the dangerous matter that slips by the more general purification processes. In order to obtain sterile water for drinking purposes and still keep the expense of installing and operating the purification and sterilization systems of any community within the bounds which will warrant its serious consideration, it has been suggested that our Municipal Water Supplies be operated as a Dual System. The advocates of such a plan propose that absolutely sterilized water be piped to all private houses, drinking fountains, etc., and wherever water is required for cooking and drinking; a second system of filtered or storage water to be piped for municipal purposes, fire department use, street cleaning, public lavatories, manufactories, etc. It is to be regretted that inefficiency, graft and incompetency in our city governments—as well as State and Federal—have increased taxation to such a point that the cost of needed plants to promote health and safeguard the population is often the pivotal issue and result in health being sacrificed and considered secondary to far less important matters. The supply of drinking water to a city is a matter for municipal control—not necessarily municipal ownership—but water should be obtained, treated and delivered not for profit alone, but for the health and convenience of the inhabitants who should pay for such water and service what it is worth and thus guarantee a fair return on the



# REPORT ON THE PROGRESS OF THE WORK DURING THE YEAR 1900

Prepared by the Board of Directors of the American Museum of Natural History

Date	Place	Object	Description	Remarks	Total
Jan 1	New York	Fossil	Fossil of a new species	Found in the same locality as the previous one	1
Feb 1	New York	Fossil	Fossil of a new species	Found in the same locality as the previous one	2
Mar 1	New York	Fossil	Fossil of a new species	Found in the same locality as the previous one	3
Apr 1	New York	Fossil	Fossil of a new species	Found in the same locality as the previous one	4

money actually invested in the construction and operation of such plants. No community is justified in discharging their sewage and garbage into a lake or body of confined water and taking their drinking water from the same body of water, no matter what the peculiar conditions may be and no matter how they may strive to justify their foolish acts. Such sewage and garbage should be destroyed, even though the destructive plants are very much more expensive than water purification plants and in addition the water used for Municipal purposes should be filtered and purified and that used for drinking and domestic purposes, sterilized.

#### **Statistics of Large American Municipally Owned Water Systems**

The United States Department of Commerce, Bureau of the Census, in the General Statistics of Cities gives some interesting figures in regard to the Municipally owned water supply systems in 155 American cities of over 30,000 inhabitants. The total stated value of the systems is \$1,071,201,511 or about \$40 per person served. Of this cost 32.7% or \$350,000,000 is represented by the New York system alone.

Rivers and small streams furnish the water for 67 of the cities; wells supply 33 entirely and lakes or ponds 21. Twenty-six cities obtain water from two or more sources. Impounding reservoirs are in use in 40 of the cities; distributing reservoirs in 114 cities and both impounding and distributing in 13. Standpipes are in use in 73 cities, the greatest number being 12 in Pittsburgh, Pa. Wells are in use in 49 cities, but in 16 of them they only furnish part

of the supply. These wells vary in depth from 3,000 feet in Dallas, Texas, to extremely shallow ones. The diameter of the driven wells varies from six inches to 26 inches, the majority ranging from six inches to 14 inches. Lincoln, Nebraska, has one well 40 feet in diameter and 60 feet deep; Topeka, Kansas, has two wells 60 feet and one 48 feet in diameter, all about 47 feet deep. Generally similar wells are in use in Schenectady, N. Y., and Spokane, Wash., and they have been spoken of as "collecting galleries" of a subterranean "water table." Natural water pressure at the point of discharge is reported in eight cities.

Of the 155 cities reporting municipally owned water supply systems, only 73, i. e., 47% employ purification processes. Appended is a table giving the different purification processes now in use in these cities and the cost of treatment per million gallons.

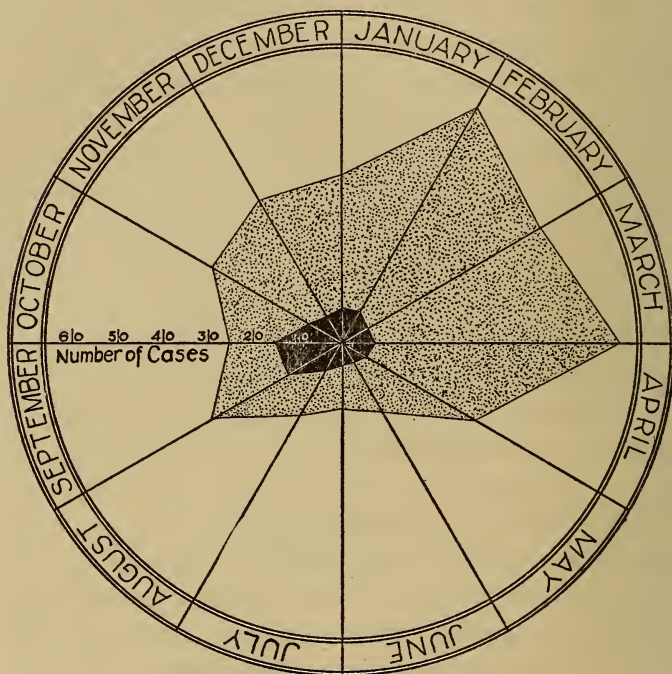
Five processes of purification are employed, viz.: sedimentation, coagulation, slow sand filtration, mechanical filtration and chemical disinfection, which is popularly termed sterilization. The coagulation process is always used in connection with one or more of the other processes.

There are 87 sedimentation reservoirs in 32 cities treating 958,600,000 gallons per day; 527 slow sand filters in 17 cities treating 598,700,000 gallons per day; 439 mechanical filters in 35 cities handling 469,600,000 gallons daily. In 26 cities 492,100,000 gallons per day, it is reported, are treated by coagulation and in 42 cities a total of 1,972,900,000 gallons are treated daily by chemical disinfection or so-called chemical sterilization.

**Typhoid in the United States Compared With Europe**

It has been said that "The science of water purification has developed mainly, due to the zeal and enterprise of the growing cities in America which have realized that one of the most essential factors for the well being of a community is an ample supply of clear and wholesome water." Such eulogistic and apparently authoritative statements are unwarranted by the facts. We could more truthfully say that in America we have striven in our water purification plants (aside from influencing political considerations) to get results quickly and cheaply only when positively compelled to attempt to do so and this with the least annoyance and interference with our generally unhygienic and unsanitary mode of living. The United States Government Official Bulletins tell us the unvarnished but absolute truth when they say, "The undue prevalence of typhoid fever in the United States *has been characterized as a National disgrace*, and this characterization is not unreasonable or unjust, in view of the fact that much of the typhoid fever is preventable by one simple measure—the installation of a safe water supply. Theoretically, typhoid fever is a preventable disease to the point of complete eradication." The proper disposal of excreta of the entire population is still far from attainment and "Instead of being able to destroy the infective agent at its source in feces and urine, we are compelled by expediency to attempt to prevent the entrance of the germs into the human body by making our water and milk supplies safe." Cities which neglect to properly purify their water "would be exposed also to outbreaks of Asiatic cholera

should persons ill with cholera or 'carriers' gain access to the United States. \* \* \* The average American citizen displays toward sanitary problems a very dangerous apathy. It is difficult to arouse



*Showing seasonal distribution of typhoid fever, Albany, N.Y., for nine-year period before and nine-year period after filtration. The stippled area represents typhoid previous to filtration; the black area represents typhoid after filtration. (From the 1910 report of the Albany water department.)*

FIG. 13.

his interest in anything so common as typhoid fever—it has been all about him always, excites no terror and is viewed indifferently as an inevitable

visitation which comes every year and takes its toll from the community. He rarely asks himself is this visitation inevitable, or may not typhoid fever be prevented or reduced? \* \* \* Instances may be cited where a public water supply grossly polluted with sewage and an appalling typhoid rate were accepted without murmur by the citizens for years until the taste of oil and chemicals caused a popular demand for moving the water intake further out into the lake or for a filtration plant. \* \* \* Typhoid fever is more dangerous in its transmissibility, more expensive in its lingering course and more disastrous in its sequelae than Asiatic cholera."

The Health Officer of an American city is inclined to boast if the typhoid death rate of the community under his medical supervision, does not exceed 20 per 100,000 people per annum, but in Europe such a so-called "low" rate would be considered outrageously high and positively disgraceful, calling forth acrid denunciation and demanding that a thorough investigation be instantly inaugurated and that prompt steps be immediately taken to overcome the causes leading to such a public menace with its fearful mortality. In the cities of Northern Europe that have had safe water supplies for years, the typhoid rate is seldom in excess of 5 per 100,000. Fifty registration cities in the United States, each having over 100,000 inhabitants and with an aggregate population of over twenty million, had an average typhoid death rate for 1910 of 25 per 100,000. Compare this figure

with the typhoid records of the following European cities:

	1909	1910		1909	1910
Stockholm	0.5	4.0	Bristol	2.8	2.1
Christiania	1.7	2.0	Nuremberg	2.6	...
Munich	1.9	1.4	Birmingham	5.0	3.9
Edinburgh	1.2	2.0	Belfast	5.2	3.9
Vienna	2.8	4.0	Lyons	5.8	4.4
Hamburg	3.3	4.1	Leeds	7.2	3.8
Berlin	4.2	4.0	Liverpool	8.4	3.9
Dresden	4.2	2.2	Sheffield	9.4	3.0
Copenhagen	2.7	3.6	Rotterdam	6.4	6.5
London	2.2	4.0	Amsterdam	3.8	6.7
Frankfort	1.5	0.9	Paris	8.4	5.6
Antwerp	1.0	2.3	Leipzig	8.3	7.5

The 33 principal cities in Northern Europe, with an aggregate population of 31,500,000, had an average typhoid death rate per 100,000 inhabitants of 6.5 in 1909 and 1910. This includes such notorious typhoid centers as Petrograd, which uses in part, raw and polluted Neva water and had a typhoid mortality rate of 33.7 in 1910; Warsaw with 17.4 and Moscow with 15.0. The U. S. Government reports state "A conservative estimate for 1910 will place the deaths from typhoid fever above 25,000" and the number of cases is estimated as ten times the number of fatalities or 250,000. "In 1909 there were more cases of typhoid fever in the U. S. than cases of plague in India, in spite of the fact that India's population is two and a half times that of the United States. From January 1907 to October 1911 there occurred in Russia 283,684 cases of Asiatic cholera. This included the appalling epidemic of 1910. According to a conservative estimate there occurred in the United

States during the same period one and a quarter million cases of typhoid fever, or more than four cases of typhoid fever in the United States for every case of cholera in Russia. We heard a great deal of the ravages of cholera in Italy in 1910-1911, yet in these two years there occurred in Italy about 16,000 cases of cholera and about 6,000 deaths, and in the United States in the same period we had more than half a million cases of typhoid fever and fifty thousand deaths. We are accustomed to speak of these countries as pest ridden and a residence there or even a brief visit is often considered with apprehension, while we regard the prevalence of typhoid fever in our own country with little concern."

The economic loss to the country from typhoid is appalling and is estimated by our Government experts at not less than \$100,000,000 annually, Typhoid is caused by contaminated water, milk which, in turn, may be infected by water used for cleaning utensils, or adulteration, and vile, unsanitary conditions; but water is directly or indirectly responsible for probably 80 or 90 per cent. of all the cases of typhoid experienced. The use of sterilized water for drinking, cooking and the cleansing of vessels used for handling foods and liquids, together with proper sanitation and strict conformation to well known and clearly defined hygienic laws on the part of the community and the individual, would eliminate from our midst the horrible scourge of typhoid with its dreadful toll.

#### **Mineral Waters—Medicinal Properties**

No absolute line of demarcation can be drawn between ordinary waters and mineral waters.

## TABLE OF TYPICAL MINERAL WATERS

Type of Water	Indifferent	Earthy	Salt	Salt	Sulphur	Iron	Alkaline	Alkaline	Table	Purging
Example									Water	Water
Temperature if classed as "Thermal"	Gastein	Leuk	Kissingen	Sea Water	Aix-la Chapelle	Schwalbach	Vichy	Carlsbad	Selters	Hunyadi Janos
	95-118° F.	123.8° F.			113-140° F.		105-108° F.	119-138° F.		
Solids	Amount of Solid Constituents to 1,000 Parts.									
Bicarbonate of Soda	.....	.....	.....	.....	0.645	0.021	4.883	1.92	1.2	.....
Bicarbonate of Potash	.....	.....	.....	.....	.....	.....	0.352	.....	.....	.....
Bicarbonate of Magnesia	0.0017	0.013	0.017	0.45	0.051	0.212	0.303	0.18	.....	.....
Bicarbonate of Calcium	0.0195	0.012	1.06	2.38	0.157	0.221	0.434	0.43	.....	.....
Sulphate of Soda	0.0208	0.050	.....	.....	0.283	0.008	0.292	2.37	.....	15.9
Sulphate of Potash	0.0135	0.038	.....	.....	0.153	0.004	.....	0.16	.....	.....
Sulphate of Magnesia	.....	0.308	0.588	2.96	.....	.....	.....	.....	0.46	16.0
Sulphate of Calcium	.....	1.520	0.389	0.25	.....	.....	.....	.....	.....	.....
Sulphide of Sodium	.....	.....	.....	.....	0.014	.....	.....	.....	.....	.....
Chloride of Sodium	0.0428	.....	5.52	25.21	2.616	.....	0.534	1.03	2.2	1.3
Chloride of Potash	.....	.....	0.286	.....	.....	.....	.....	.....	.....	.....
Chloride of Magnesia	.....	.....	0.303	3.39	.....	.....	.....	.....	.....	.....
Carbonate of Iron	0.0005	0.023	0.277	.....	.....	0.084	.....	0.003	0.01	.....
Silicic Acid	0.0496	0.036	.....	.....	.....	0.032	.....	.....	.....	.....
Gases										
Carbonic Acid	.....	.....	3.19	.....	.....	5.35	2.6	0.76	2.24	0.45
Hydrosulphuric Acid	.....	.....	.....	.....	Trace	.....	.....	.....	.....	.....

Mineral waters usually contain a high mineral content, but some ordinary drinking waters contain more mineral constituents than other waters universally classed as mineral waters; many comparatively pure waters, both cold and warm, have for ages been known as Mineral Springs. Mineral waters are found in all parts of the globe, without regard to latitude, longitude or altitude, but they are more prevalent in volcanic regions while few are found in very flat sections. Mineral waters resolve themselves into weaker and stronger solutions of salts and gases in waters of higher or lower temperature; for medicinal purposes they are used either internally or externally. They are generally classed under the head of a predominating element; the table of Types of Mineral Waters on opposite page has the merit of comparative simplicity.

From time immemorial writers have praised certain mineral waters. Wonderful healing properties have been attributed to these waters by the medical profession and by their sacerdotal and superstitious predecessors; waters have been exploited and from the earliest days, history and tradition tell of pilgrimages to waters in order that the sick might be benefited by the wonderful curative power of mineral springs. Such waters have been described as "inexhaustible fountains of health" and one mediaeval writer states that the chalybeate waters of Dulwich Wells are "a certain cure for every ill to which humanity is heir." Hartwig has written "How truly wonderful is the chain of processes which first raises vapors from the deep and eventually causes them to gush forth from the entrails of the earth laden with blessings and enriched

with treasures more inestimable than those the miners toil for." Another writer has said "Nature of her bounty has furnished us with innumerable healing springs to help us to remedy the ills we have brought upon ourselves by errors of diet and living." Some so-called mineral waters are naturally impregnated with carbonic acid gas which, under certain conditions, may irritate the stomach and under other conditions, may tend to stimulate and prove an aid to digestion. The much esteemed Selters water (Seltzers) is a natural water found in the valley of Niederselters in the German Province of Hesse-Nassau; it contains chiefly carbonic acid, bicarbonate of soda and common salt, being therefore, a charged salt and alkaline water; substitutes for this water are manufactured very extensively. Appollinaris is said to be a natural aerated acidulated soda water obtained from a spring in the valley of the Aar, near the Rhine; this water is in great demand as a beverage, but the fact that the bottling establishment connected with this spring as well as many other "naturally charged" mineral waters, receive carload shipments of carbonic acid gas in drums is significant. French Vichy is an alkaline water and nothing more. It is harmless and for certain constitutions most healthful. The Celestin Vichy (French government bottling) may be flat and insipid, slightly or moderately aerated, whereas the Dubois bottling, claimed to be the natural mineral water from the heart of the vichy district, is highly charged with carbonic acid. It is said that charged mineral waters stimulate the appetite and some extremely sensitive people have even claimed that certain carbonic acid waters, highly charged,

are not only stimulating but mildly intoxicating. Good, reliable bottled waters with mild mineral content, flat or very mildly aerated, with general national and preferably international distribution, are a boon and valued safeguard to the traveller who can use one standardized water wherever he journeys, and thus eliminate the possible ills resulting from the consumption of variable waters that generally demand more or less physical adjustment; also the greater evil in the form of possible infection from the use of contaminated waters. The selection of a bottled and so-called healthful mineral water should not be lightly made, for commercialism is at times apt to run rampant, especially in our own country, and where ignorance, avarice and hysterical exploitation are substituted for conservatism and medical knowledge, disastrous results may follow. The following extract from a reputable California paper, under large conspicuous headings, is illustrative of our national contempt for both truth and health:

"Through a special process perfected at A—P—Co. recently, a high grade mineral water has been obtained from the drawing of a ——— composition which is said to contain many strength-giving chemicals. As a consequence the ——— is seriously considering the matter of making this mineral output one of the by-products of the Company, and inasmuch as it contains many chemicals of value which are not to be found in the natural composition of any so-called health water, it is more than possible that the output may find a heavy demand. Company chemists who have taken the formula of the water, report that it contains many valuable minerals. The water, though taken from a highly brackish composite fluid, has a pleasant taste and is in no way similar to that of any other mineral water."

Water, contaminated with sewage and death-dealing, is also apt to have a pleasant taste and would probably be fully as healthful as the waste water from a chemical operation, heavily charged with organic matter. It would be well for all careful people to taboo the use of all mineral and bottled waters, unless their reliability and wholesomeness is proven by continual analysis and unquestioned expert endorsement, all backed by the experience coming from years of usage.

To "take the waters" used to be a healing process enjoyed only by the most favored members of society, but now most of the waters are bottled and can reach the homes of the poorest. The efficacy of mineral waters seems to be lessened greatly when the waters are taken at home and away from their natural font. If a person truly cares to take the famous mineral waters of either Europe or this country they could be duplicated at very small expense. It is not, however, the mineral in the water that heals, at the famous Health Resorts, but the Rules of the Game, which consist of healthful routine, proper diet, no dissipation, common sense treatment, the using principally of nature's own remedies such as pure air, sunshine, exercise and plenty of water taken at the right time. The average patient who visits the famous Mineral Springs, goes to a different climate and generally experiences a change in altitude at a time of the year which would naturally prove beneficial to him (the Health Resorts have seasons). His diet is altered and the abuses to his stomach are mostly eliminated. His erratic hours of rest and social dissipation are changed to regularity, early retiring and rational hours of sleep

with absolute relaxation. Business cares and nervous worries are laid aside, exercise is demanded, good pure air fills his lungs, scientific bathing opens the pores of his skin, and with a natural diet his bodily organs function normally, eliminate waste, purify the blood and tone up his run-down constitution. Nature performs the wonderful cure generally attributed to waters. As a rule the mineral content of waters has no influence whatever in bringing such a patient back to health, but mineral waters may be the magnets, like the relics of the Saints, in drawing bodily sick pilgrims to the Shrines of Health. Rob the water of its minerals but retain its freshness and springlike purity and subject a patient to the same Health Resort treatment, giving him an average wholesome water but the same measure of nature's bounty administered with intelligence, and the man would be healed without the mineral content of water. The virtue of the mineral constituents of water is also intensified by suggestion. The patient going to take a cure exhibits faith or belief in the efficacy of a few mineral salts mixed in his drinking and bathing water; therefore, the patient is psychologically benefited as soon as his treatment begins, for there is no doubt that the mind has a wonderful influence on the health and well-being of the body. The treatment at Mineral Water Resorts has another great advantage over other pathological methods of treating the sick. Less poisonous drugs are administered, the "wonderful" waters take their place and therefore the system has only one disease or error to fight off instead of two or more.

## II.

### MILK

**M**ILK may be defined as an opaque, creamy white fluid secreted by the mammary glands of female mammals for the nourishment of their young. In chemical constitution it consists of an emulsion of fatty globules (cream) in a watery, slightly alkaline solution (when fresh) of salts, casein and a variety of sugar peculiar to milk, named lactose or milk sugar. The fat (which when separated we know as butter) and the lactose constitute the carbonaceous portion of the milk regarded as food. The casein, which forms the principal constituent of cheese together with a certain amount of albumen, form the nitrogenous, while the complex saline substances are the mineral constituents. The water in milk serves the purpose of holding in solution the soluble constituents of the milk and it also acts as a diluent, making the mixture adaptable for animal digestion and nutrition.

Maternity is the prime incentive to the secretion of milk, and it is a fluid which is only secreted for a certain period of time after parturition. The immediate stimulus to the production of milk is the turning of the blood that went to nourish the fetus from the arteries of the womb to the arteries of the udder or breast. The pressure of blood in these glandular organs stimulates the secreting cells to great activity, and the cells, hitherto dormant, multiply

rapidly. The milk is formed from the blood and the amount of milk secreted depends upon the blood vessels, the vigor of circulation, the food eaten and the capacity to digest and assimilate the food and turn it into blood rich with nutrients. With wild animals, in a state of nature, the milk is secreted only in an amount sufficient for the needs of the offspring and the period of the milk flow ceases when the young are sufficiently developed to obtain their food supply independent of the mother. Under the influence of domestication, the cow has been encouraged or developed to increase the flow of milk many fold and the time during which it is secreted has been lengthened, until it is almost and in some cases is quite continuous. Wing has said that "A vigorous calf would not need more than 20 pounds of milk per day for the first four months of its life, or 2,400 pounds of milk, and this, or less, would be all that a normal wild or semi-wild cow would be likely to produce in a year. Numerous cows have produced more than ten times this amount, or 24,000 pounds of milk in a year, the largest authentic amount on record being, it is said, 30,318.5 pounds of milk given by the Holstein cow Pieterje 2d in 1888."

Experienced Dairymen seem to agree that whereas cows may secrete milk continuously for two or three years without producing a calf, yet parturition serves to stimulate the secretion of milk to such an extent that it is better, and in the end more economical, for the cow to produce a calf at regular intervals each year and, as a result, to have a short annual rest of 2 to 4 weeks as a milk producer before calving; and this regardless of the value of the calf when born. The good effect of

the dry period of a cow is largely physiological and the secreting glands in the udder are stimulated to greater activity if they are favored with a brief annual period of inactivity.

Animal	Authority	Water	Total Solids	Fat	Casein	Albumen	Sugar	Ash
Cow	Koenig	87.17	12.83	3.69	3.02	0.53	4.88	0.71
Cow	Snyder	87.0	13.0	4.0	3.25		5.0	0.75
Cow-Skim milk	Snyder	90.25	9.75	0.1	3.70		5.15	0.80
Cow	Blyth	86.87	13.13	3.50	4.75		4.0	0.70
Cow	Douglas	87.5	12.5	3.50	3.65		4.60	0.75
Cow	Cameron	87.0	13.0	4.0	4.10		4.28	0.62
Cow	Wiley	87.4	12.6	3.9	3.00		5.0	0.70
Ewe	Koenig	80.82	19.18	6.86	4.97	1.55	4.91	0.89
Ewe	Voelcker	83.70	16.30	4.45	5.16		5.73	0.96
Sheep	Aikman	83.0	17.0	5.3	4.6	1.7	4.6	0.8
Sheep	Douglas	81.08	18.92	7.67	6.08		4.26	0.91
Sheep	Snyder	82.25	17.75	5.3	7.10		4.35	1.0
Goat	Koenig	85.71	14.29	4.78	3.20	1.09	4.46	0.76
Goat	Aikman	85.5	14.5	4.8	3.8	1.2	4.0	0.7
Goat	Voelcker	84.48	15.52	6.11	3.94		4.68	0.79
Goat	Wiley	89.05	10.95	3.4	2.80		3.8	0.95
Mare	Koenig	90.78	9.22	1.21	1.24	0.7	5.67	0.35
Mare	Snyder	88.49	11.51	2.86	3.35		4.75	0.55
Mare	Cameron	90.31	9.69	1.06	1.95		6.28	0.37
Mare	Wiley	90.32	9.68	1.00	1.90		6.33	0.45
Ass	Koenig	89.64	10.36	1.64	0.67	1.55	5.99	0.51
Ass	Chevallier & Henry	91.65	8.35	0.11	1.82		6.08	0.34
Ass	Wiley	91.51	8.49	0.93	1.60		5.60	0.36
Sow	Koenig	84.04	15.96	4.55	7.23		3.13	1.05
Sow	Bunge	82.3	17.7	6.9	5.9		3.8	1.1
Sow	Snyder	84.0	16.0	4.6	7.25		3.15	1.05
Dog	Koenig	75.44	24.56	9.57	6.10	5.05	3.08	0.73
Dog	Bunge	75.6	24.4	12.5	5.2	1.9	3.5	1.3
Cat	Koenig	81.63	18.37	3.33	3.12	5.96	4.91	0.58
Cat	Bunge	81.7	18.3	3.3	3.1	6.4	4.9	0.6
Buffalo	Koenig	81.41	18.59	7.47	5.85	0.25	4.15	0.87
Buffalo	Douglas	82.57	17.43	7.63	4.69		4.30	0.81
Camel	Koenig	86.57	13.43	3.07	4.00		5.59	0.77
Mule	Koenig	91.50	8.5	1.59	1.64		4.80	0.38
Llama	Koenig	86.55	13.45	3.15	3.00	0.90	5.60	0.80
Elephant	Koenig	67.85	32.15	19.57	3.09		8.84	0.65
Porpoise	Koenig	41.11	58.89	45.80	11.19		1.33	0.57
Rabbit	Bunge	69.4	30.6	10.5	15.5		2.0	2.6
Guinea Pig	Bunge	41.1	58.9	45.8	11.2		1.3	0.6
Reindeer	Bunge	68.2	31.8	17.1	8.4	2.0	2.8	1.5
Whale	Douglas	60.47	39.53	20.0	12.42		5.63	1.48

The milk of any family of animal life is particularly and specifically adapted to the proper growth of the offspring of that particular species.

The ingredients in the composition of the milk of different animals is practically the same, although a considerable variation occurs in the proportion in which the different constituents are present. The table on opposite page gives the composition of the milk of different animals as determined by various authorities.

Development of offspring may be furthered by milk of a foreign nature which is not to be compared, however, with natural maternal milk for the young. Bunge found that dog's milk had a mineral content exactly the same as that of a new born puppy. And the constituents in the milk of any mammal corresponds, with the composition and nature of the animal body. The caseins of different milks are different in chemical behavior and the rennet of the stomach is apparently specifically adapted for the coagulation of the casein produced by the female of the same race. Bunge has also shown that the percentage quantity of the constituents in the milk is dependent upon the rapidity of the growth of the organism.

Animal	Time in days for the new-born animal to double its weight		100 parts of milk contain		
			Protein	Ash	Calcium Oxide
Human	180		1.6	0.2	0.033
Horse	60		2.0	0.4	0.124
Calf	47		3.5	0.7	0.160
Kid	19		4.3	0.8	0.210
Pig	18		5.6		
Lamb	10		6.5	0.9	0.272
Dog	8		7.1	1.3	0.453
Cat	7		9.5		

Rubner and Heubner have shown by experimentation that the assimilation of milk is generally better accomplished in healthy children than in adults. Blauberg reports the following percentage absorption of the ash of cow's and human milk:

Kind of Milk	Subject	Per cent. of milk ash absorbed
Cow's	Infant	60.70
Diluted cow's	"	53.72
Human	"	79.42
Human	"	81.82
Cow's	Adult	53.20

The absorption of the energy-creating constituents of the milk is remarkably constant. This is illustrated by Rubner's experiments which show the physiological utilization of the total calories (fuel or food value) of milk:

	Percentage of Calories absorbed
Human milk	91.6 to 94.0
Diluted cow's milk	90.7
Diluted cow's milk + milk sugar	92.2
Cow's milk given adult	89.8

According to Praunitz, milk is more poorly assimilated in the intestines of adults than other animal foods. The following table shows the assimilation of the various kinds of milk and milk products, according to Koenig:

Kind of Milk or Milk Product	Composition			Amount Assimilated		
	Protein	Fat	Sugar	Protein	Fat	Sugar
Cow's Milk	3.39	3.68	4.94	3.19	3.49	4.84
Goat's Milk	3.76	4.07	4.64	3.53	3.87	4.55
Sheep's Milk	5.15	6.18	4.17	4.89	5.87	4.05
Ass's Milk	1.85	1.37	6.19	1.79	1.30	6.01
Butter	0.86	83.70	0.80	0.55	81.19	0.49
Fatty Cheese	26.21	29.50	3.39	24.90	26.58	3.32
Lean Cheese	35.59	12.35	4.22	31.81	11.11	4.14

The following is the nutritive value of the various kinds of milk and milk products, based on the above composition, expressed in calories per pound:

Cow's Milk	306	Calories
Goat's milk	324	"
Sheep's milk	429	"
Ass's milk	85	"
Butter	1,124	"
Fatty Cheese	1,731	"
Lean Cheese	852	"

The analysis of human (mother's) milk is given by various authorities as follows:

Authority	Water	Casein	Albumen	Fat	Milk Sugar	Ash
Bunge	88.61	1.16	0.47	3.40	6.13	0.23
Lorand	87.78	0.80	1.21	3.74	6.37	0.30
Koenig	87.41	1.03	1.26	3.78	6.21	0.31
Richmond	86.03		1.27	5.61	6.98	0.18
Gerber	88.02		1.60	2.90	7.03	0.31
Wiley	88.30		1.50	3.50	6.50	0.20
N. Y. Tests	87.75		1.50	3.70	6.40	0.30

The following comparison of the relative percentage composition of average cow's milk and human milk, taken five and a half months after parturition, is of interest:

	Human		Cow's	
	Rubner and Heubner	Soldner	Rubner	Van Slyke
Protein	1.0	1.52	3.41	3.2
Fat	3.0	3.28	3.65	3.9
Milk Sugar	6.4	6.50	4.81	5.1

Or, expressed in the relative calorific value of the different constituents, the Rubner analyses may be stated as follows:

	Human	Cow's
Protein	7.4	21.3
Fat	43.9	49.8
Milk Sugar	48.7	28.9

There are, therefore, tremendous differences in the composition of cow's milk and human milk, which fact forces the conclusion that cow's milk is not to be substituted for human milk in rearing a child and should never be considered if a mother is physically capable of suckling her baby. In case of the positive inability of a mother to directly nurture her offspring, cow's milk or some other animal's milk can be used if scientifically modified, but such food substitution should be considered solely as an emergency measure, and never advocated or even considered by any mother in good or average health and with normal breasts.

Camerer has found that human milk drawn 3 to 12 days after parturition contains 0.2 milligrams of iron oxide per 100 c.c., while the later milk contains 0.1. The quantity is decreased if the environment or the condition of the mother be poor. Using the customary methods of infant feeding with cow's milk, the child obtains too little iron. The quantity of calcium in cow's milk is in excess of the needs of the human infant. Patein and Daval report that human milk after the first month of lactation contains but 0.8 to 1 per cent. of casein, or one-third to one-fourth of that of cow's milk. Another distinction between cow's and human milk, commented upon by Rubner and Heubner, is that cow's milk contains but little extractive nitrogen (which contains a considerable amount of carbon), while human milk may contain 18 to 20 per cent. in that form. Lusk says, "The large protein content of cow's milk may be bad for the child. In the first place, it clots in a heavy mass in the baby's stomach, and in the second place, even though it be digested,

it is relatively much above the requirements of the organism and its specific dynamic action increases the amount of heat produced." Cow's milk can, of course be diluted with water so that its protein content may approach that of human milk, but such dilution reduces the quantity of fat and carbohydrates and these must be kept in the milk or added to the diluted milk in order to make a proper and well-balanced diet for a child. To obtain the needed fat content, "top milk" rich in fat may be taken from milk which has been standing, milk sugar may be used to augment the carbohydrate content, lime water to give an alkaline reaction and water to dilute the whole to the proper proportion of the prime constituents. Such a milk called "Modified Milk" was first introduced by Rotch of Boston, and is used quite extensively to-day. Human milk has a varying food value, dependent largely on the amount of fat present. Schlossmann gives the calorific value per litre of 19 samples of milk from different women as maximum 876, minimum 567, average 719 calories per litre, or 327 calories per pound, which is about the same as goat's milk and a little greater than the theoretical food value of cow's milk.

Lusk says that the so-called "scientific" feeding of infants with substitutes for mother's milk is unworthy of the name unless the calorific requirement is carefully considered. "From lack of this knowledge babies are frequently systematically starved." Nature provides the proper food for the young of every species and where man either wilfully, or from necessity, separates a child from its natural fountain of nourishment, the responsibility to produce food

to equal or vie with that provided by an all-wise nature is great, and far beyond the sense of appreciation of ninety-nine per cent. of the Medical Profession, not to mention the average non-technical parents. The following tests on Metabolism with infants using Mother's Milk and Modified Cow's Milk are of interest:

Authority	Age of Child months	How fed	Food Ingested Calories	Meta- bolism Calories	Added to child's organism Calories	Per Cent.
Rubner and Heubner	7.5	Modified cow's milk	682.8	593.2	89.6	12.2
Camerer	9.0	Breast fed	480	420	60	15.

It has been truly said that it is wonderful how a child's intuitive appetite can "determine the ingestion of nutriment necessary to cover the energy requirements of his organism, and a small addition for normal development. A reduction of 15 per cent. in the intake of food would bring his prosperous growth to a standstill." Dr. Holt, in his well-known catechism for mothers on the care and feeding of children, says that mother's milk is composed of 13 parts solids and 87 parts of water. The solids consist of fat, which is the cream, milk-sugar, proteids (the curd of the milk) and salts, and a healthy infant cannot be reared unless all these constituents are in his food in the proper proportion. Fat, he says, is needed for the growth of bones, nerves, the fat of the body and the production of heat; sugar produces heat and makes fat; proteids are needed for the growth of the body cells; salts are needed for the making of bone, the functions of digestion and the "toning" of the en-

tire system. The water in the milk keeps the food in a state of minute subdivision, or in solution, so that the delicate organs of the infant can digest it, and it is also necessary for circulation in the body and to enable the system to eliminate its waste. There is no perfect, or even very satisfactory substitute for good breast-feeding, and the mortality of bottle-fed infants during the first year is fully three times as great as that of those who are breast-fed, but "if a mother has, or has had, tuberculosis or any other serious chronic disease, or is herself in very delicate health, she should not try." Holt also says that we can "modify" cow's milk so that the great majority of healthy infants can digest it and thrive on it, but it must be remembered that there are differences which cannot be wholly overcome and we cannot make cow's milk into human milk—the species of animal life are entirely different. The milk of each species differs from that of all other species and there are peculiar properties physical and chemical in mother's milk (many not yet thoroughly understood or appreciated) which cow's milk does not possess. Cow's milk has a little more than half as much sugar and three times as much proteids and salts as mother's milk; its proteids, fats and salts are different and much more difficult of digestion, and its reaction is much more acid. Moreover, human milk as fed to a child is always fresh and sterile, and no animal milk, no matter how treated or handled, can be given an infant that does not contain some dirt and an abundance of bacteria, and although, fortunately, such Micro-organisms are generally harmless, there is always present a possible risk of infection. San-

ford and Wilson, in Dr. Lusk's Laboratories, made some interesting tests which indicate that the growth of young animals is generally proportional to the calorific value of the milk fed to them. The experiments were conducted for about two weeks with suckling pigs weighing from 1050 to 1485 grams each at birth, and from 1890 to 2471 grams at the end of the tests. Some were fed with skim milk and others with milk fortified with glucose and milk sugar with total calorific values of food for the period varying from 3736 to 5216 per animal. The results showed that pigs of different litters and of different sizes and differently fed, gained in weight respectively 213, 214, 215, 218 and 222 grams per 1000 calories of the total quantity of food ingested. Heubner has said that the average normal infant requires 100 calories per kilogram (2.2 lbs.) of body weight for normal nutrition during the first three months of life; 90 calories during the second three months and 80 and less thereafter. The energy content of the food should never sink below 70 calories per kilogram, which is about the maintenance minimum.

#### **Ass's Milk**

Ass's milk most closely resembles human milk. It is easily digestible and is used at times in the Latin countries of Europe as food for feeble children and weak persons. In ancient times, quite a number of healing properties were ascribed to ass's milk, and we are told that Nero's consort, Poppæ Sabina, when on a journey always took along 500 asses, in order to be able to bathe in their milk. In Barcelona, asses with covers marked "Approved

by the College of Physicians" are taken from door to door and milked for each customer. Asses are not subject to tuberculosis and their milk contains fewer bacteria than other kinds of milk. Its rather sweet taste is not agreeable to every one and its high price and scarcity operate against its general use, although the latter condition could be remedied if the animals were raised in large numbers. It has a specific gravity of about 1.036.

### **Sheep's Milk**

Sheep's milk is the most nourishing of all the milks obtained from the various animals domesticated by the Caucasian race. In the Dutch Provinces of Friesland and in Iceland, the Pyrenees, Appenines and Corsica, the milch sheep are found in great numbers and such sheep give five or six quarts of palatable milk per day each. The chief characteristic of sheep's milk is its high fat content and this is said to be increased at times by feeding the sheep with substances containing oil. Sheep's milk has a specific gravity of 1.035 (Koenig gives a minimum of 1.0298; maximum 1.0385), and it contains a considerable amount of iron. The ash contains 1.01 per cent. of oxide of iron, 30.17 per cent. of phosphorus, 31.12 per cent. of lime, and 7.63 per cent. of chlorine. When sheep's milk is evaporated, Koenig says that it contains 31.33 per cent. of protein, 37.6 per cent. of fat, 38.84 per cent. of milk sugar and 4.59 per cent. of nitrogen.

### **Goat's Milk**

Goats milk resembles that of the cow in some respects but it contains more albumen and generally

much more fat. The great objection to goat's milk is its unpleasant and even offensive odor although this can be overcome to a great extent by proper care and determined mode of life. The fat content of goat's milk, like the sheep's, is increased by the use of oily or fatty food. Dr. Lorand says, "While staying on the Island of Capri, where this milk is much used, I found it much more digestible than cow's milk. This variety of milk deserves more attention than it receives, especially since the upkeep of goats entails but little expense, as the animal is much less particular in regard to the quality of its food than is the cow. The greatest care must be exercised in regard to absolute cleanliness and in this way the milk may be kept free from any objectionable odor." Goat's milk has a specific gravity of 1.030; Koenig gives a minimum of 1.028 and a maximum of 1.0360. Lorand quotes an analysis attributed to Koenig which gives the water content at 86.88 per cent., fat 9.07, sugar 9.69, casein and albumen 3.76 and ash 0.85. Dr. Bell reported to the New York Academy of Medicine in 1906 the results of his successful experience with goat's milk for infant feeding, and further stated "I believe good milch goats (the Nubian for instance) will give a larger milk ratio per unit expense of food and keeping than the cow. She is more docile, less excitable, not subject to tuberculosis or other disease in this climate. Being a browser rather than a grazer she will thrive where cows would not; and above all she is cleanly. I believe an assured, non-contaminated goat's milk supply not only commercially possible, but profitable."

### Composition of Cow's Milk

The constituents of milk are numerous and of diverse character but may be generally classified as: water, fats, substances containing nitrogen (albuminoids), sugar and ash. Excepting the water, they are collectively known as milk solids. The solids exist partly in solution, partly in semi-solution and partly in suspension in the water. The compounds of milk are at times divided into arbitrary groups and a division may be made, on the basis of the milk fat, into (1) fat and (2) milk-serum, which includes all the milk constituents except the fat. Separator skim-milk is nearly pure-milk-serum.

The following arrangement shows the general relation of the compounds contained in milk and the percentage figure of average cow's milk as suggested by Van Slyke:

Milk	{	Water		{	Fat		{	Casein	
		87.1			3.9			2.5	
	{	Solids		{	Nitrogen Compounds		{	Albumen,	
		12.9			3.2			Etc.	
	{	Solids Not Fat		{	Milk Sugar		{	0.7	
		9.0			5.1				
	{	Gases		{	Ash (Salts)		{		
		Carbon Dioxide Nitrogen Oxygen			0.7				

The average composition of cow's milk according to Babcock is:



According to Farmers' Bulletin No. 29, United States Department of Agriculture, cow's milk has the following composition:

		Per Cent.		
Water	. . . . .	87.0		
Solids	{	Fat 3.6	3.6	
		{	Casein	3.3
			Albumen	0.7
			Sugar	4.7
			Ash	0.7
		9.4		
		13.0	Total	100.0

Table of Average Analyses of Cow's Milk (Van Slyke):

	Water	Total Solids	Fat	Casein	Albu- men	Sugar	Ash
Average of 5552 U. S. Analyses	87.1	12.9	3.9	2.5	0.7	5.1	0.7
Average Cheese Factory Milk for Season May-Nov. New York State	87.4	12.6	3.75	2.45	0.7	5.0	0.7

Aikman has prepared the following table of the Composition of Milk expressed in percentages:

	Fleischmann		Kirchner		American		English Average of 120,540 samples (Vieth)
	Average	Limits of Variation	Average	Limits of Variation	Average	Limits of Variation	
Water	87.75	87.5 to 89.5	87.5	83 to 90	87.00	81.1 to 91.4	87.1
Fat	3.40	2.7 to 4.3	3.4	.8 to 8.0	4.00	2 to 8	4.1
Nitrogenous Substances commonly known as Casein	3.50	3 to 4	3.9	2.28 to 5.73	3.30	2 to 4.5	8.8
Milk Sugar	4.60	3.6 to 5.5	4.5	3 to 6	4.95	4 to 5.5	
Ash	0.75	.6 to .9	0.75	.6 to .9	0.75	.6 to .9	
Total Solids	12.25	9.9 to 14.7	12.5	7.2 to 12.63	13.00	8.6 to 18.9	

Limits even wider than those cited above have been published. Thus a sample of cow's milk has been found to contain only 0.17 per cent. of fat (Vieth) while another sample has been found to contain as much as 11.06 per cent.

The results before quoted may be summarized as follows:

	Average	Limits
Water	87.34	81 to 91
Total Solids	12.66	7.2 to 18.9
Fats	3.72	.25 to 11.0
Solids—not fat	8.93	5.6 to 12.6

The solids not fat consist of 3.594 per cent. of casein and albumen; 4.614 per cent. of milk sugar and 0.73 per cent. of ash.

Wing has tabulated the following record of average analyses published by recognized authorities:

	Babcock American	Oliver English	Cornevin French
Water	87.17	87.60	87.75
Fat	3.69	3.25	3.30
Casein	3.02	3.40	3.00
Albumen	0.53	0.45	
Sugar	4.88	4.55	4.80
Ash	0.71	0.75	0.75

The following from Koenig shows the range of variation of the several constituents in nearly 800 analyses collected from all parts of the world:

	Maximum	Minimum
Water	90.69	80.32
Fat	6.47	1.67
Casein	4.23	1.79
Albumen	1.44	0.25
Sugar	6.03	2.11
Ash	1.21	0.35

An analysis of 7 per cent. of fat is extremely rare and should be regarded with suspicion unless well authenticated. The mixed milk of herds seldom falls below 3 per cent. of fat and rarely rises above 5.5 per cent.

Snyder states that the average composition of milk with the extent of range is generally as follows:

	Per Cent.	Range Per Cent.
Water	87.00	89.6 to 82.4
Fat	3.50	2.5 to 6.0
Casein	3.25	2.5 to 4.0
Albumen	0.50	0.5 to 0.8
Milk Sugar	5.00	4.3 to 6.0
Ash	0.75	0.6 to 0.8

A British authority recently stated that the range in good normal milk should be within the following limits:

Water	90.0 to 83.65	per cent.
Fat	2.8 to 4.5	" "
Casein and Albumen	3.3 to 5.55	" "
Sugar	3.0 to 5.5	" "
Ash	0.7 to 0.8	" "

Richmond has made a very large number of analyses of milk sold in England and the following tabulated results are interesting and very uniform:

Year	Number of Milks Analyzed	Total Solids	Fat
1900	13,798	12.57	3.64
1901	13,936	12.63	3.72
1902	12,914	12.73	3.82
1903	15,313	12.78	3.83
1904	15,910	12.68	3.74
1905	14,828	12.70	3.73
1906		12.64	3.71

Billitz gives the average results of 187,610 analyses of milk in Lombardy during a period of ten years as specific gravity 1.0315, Fat 3.55, Solids—not fat 8.81 per cent. The poorest milk of one herd had 2.70 fat and 8.45 other solids, and the richest milk of a herd 4.10 fat and 9.23 solids—not fat.

An analysis of skim-milk, whey and buttermilk has been given by Van Slyke as follows:

	Water	Total Solids	Fat	Casein	Albu- men	Sugar	Ash
Skim-milk (separator)	90.3	9.7	0.10	2.75	0.80	5.25	0.80
Whey	93.4	6.6	0.35	0.10	0.75	4.80	0.60
Buttermilk	90.6	9.4	0.10	2.80	0.80	*4.40	0.70

\*.60 per cent. lactic acid in addition.

### The Specific Gravity of Cow's Milk

Some of the solids of milk are heavier than water and some of them lighter, but milk as a whole has a specific gravity somewhat greater than water. The variation in the specific gravity is considerable, being from 1.027 to 1.035 at 60° F., the average being about 1.32 or a little less. In general, the effect of an increase in the solids of the milk is to increase its specific gravity, although in milk very rich in fats, the specific gravity may be lessened. Koenig gives the minimum as 1.0264 and the maximum 1.0370, with a mean of 1.0315, and compares this with human milk 1.027 minimum and 1.032 maximum; mare's milk 1.0347 mean; ass's milk 1.032 mean; ewe's milk 1.0298 minimum, 1.0385 maximum and 1.0341 mean; and goat's milk 1.028 minimum, 1.036 maximum and 1.0305 mean.

**The U. S. Official Standards for Milk, Cream, Etc.**

The Department of Agriculture has established the following official standard for purity of dairy products, defining also what is meant by the terms used in designating certain commodities.

**A. MILKS**

(1) MILK is the fresh, clean, lacteal secretion obtained by complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within 15 days before and 10 days after calving, and contains not less than 8.5 per cent. of solids—not fat, and not less than 3.25 per cent. of milk fat.

(2) BLENDED MILK is milk modified in its composition so as to have a definite and stated percentage of one or more of its constituents.

(3) SKIM MILK is milk from which a part or all of the cream has been removed and contains not less than 9.25 per cent. of milk solids.

(4) PASTEURIZED MILK is milk that has been heated below boiling, but sufficiently to kill most of the active organisms present, and immediately cooled to 50° F. or lower.

(5) STERILIZED MILK is milk that has been heated at a temperature of boiling water, or higher, for a length of time sufficient to kill all organisms present.

(6) CONDENSED MILK, EVAPORATED MILK is fresh, pure, normal milk from which a considerable portion of water has been evaporated and to which sugar (sucrose) has been added, and contains not less than 28 per cent. of milk solids of which not less than 27.5 per cent. is milk fat.

(7) CONDENSED SKIM-MILK is skim-milk from which a considerable portion of water has been evaporated.

(8) BUTTERMILK is the product that remains when butter is removed from milk or cream in the process of churning.

**B. CREAM**

(1) CREAM is that portion of milk, rich in milk-fat, which rises to the surface of milk on standing or is separated from

it by centrifugal force, is fresh and clean and contains not less than 18 per cent. of milk-fat.

(2) EVAPORATED CREAM, CLOTTED CREAM is cream from which a considerable portion of water has been evaporated.

### C. MISCELLANEOUS MILK PRODUCTS OTHER THAN BUTTER, CHEESE, FATS AND ICE-CREAMS

(1) WHEY is the product remaining after the removal of fat and casein from milk in cheese-making.

(2) KUMISS is the product made by the alcoholic fermentation of mare's or cow's milk.

### State Laws and Standards Regarding Composition of Milk and Cream.

Several states have adopted minimum standards for milk products and any milk, cream or butter that falls below the standard is considered adulterated or abnormal and unsatisfactory. The various state laws require milk with from 11.5 to 13 per cent. of total solids, from 2.5 to 3.5 per cent. of fat and 8 to 9.5 per cent. solids—not fat. Skim-milk is required to have from 8 to 9.3 per cent. of total solids in the various states, and cream from 15 to 20 per cent. of fat.

### AMERICAN STATE MINIMUM STANDARDS FOR MILK AND CREAM

	MILK		CREAM
	Total Solids Per Cent.	Fats Per Cent.	Fats Per Cent.
California	11.5	3	18
Colorado		3	16
Connecticut	11.75	3.25	16
Florida	11.75	3.25	18
Georgia	11.75	3.25	18

	MILK		CREAM
	Total Solids Per Cent.	Fats Per Cent.	Fats Per Cent.
Idaho	11.	3.2	18
Illinois	11.5	3.	18
Indiana	11.75	3.25	18
Iowa	12.	3.	16
Kansas	11.75	3.25	18
Kentucky	11.75	3.25	18
Louisiana	12.	3.5	
Maine	11.75	3.25	18
Massachusetts	12.15	3.35	15
Michigan	12.5	3.	
Minnesota	13.	3.25	20
Missouri	12.	3.25	18
Montana	11.75	3.25	20
Nebraska		3.	18
Nevada	11.75	3.25	18
New Hampshire	12.		18
New Jersey	11.5	3.	16
New York	11.5	3.	18
North Carolina	11.75	3.25	18
North Dakota	12.	3.	15
Ohio	12.	3.	
Oklahoma		3.	18
Oregon	12.	3.2	20
Pennsylvania	12.	3.25	18
Rhode Island	12	2.5	
South Dakota	11.75	3.25	18
Texas	11.75	3.25	18
Utah	12.	3.2	
Vermont	11.75	3.25	18
Virginia	11.75	3.25	18
Washington	12.	3.25	18
Wisconsin	11.5	3.	18
Wyoming		3.25	18

Other states and territories have established no legal standard.

Federal standard	11.75	3.25	18
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The British "Sale of Food and Drugs Act" fix the minimum limit for fat at 3 per cent. and that for non-fatty solids at 8.5 per cent. Milk containing less than these amounts being regarded as adulterated or "not of the nature, substance and quality demanded." The average per cent. of fat in the milk supplied by one of the principal London Dairy Companies in 1910 was 3.6 per cent. for the morning milk and 4 per cent. for the evening milk, the total solids being 12.4 and 12.6 per cent. respectively. Sohn gives the composition of mixed herds of cows supplying milk to the various towns of Great Britain as:

Protein, 3 to 4 per cent.; average about 3.5 per cent.

Fat, 3 to 4 per cent.; average about 3.5 per cent.

Sugar, 4 to 6 per cent.; average about 5.0 per cent.

Mineral Salts, average about 0.7 per cent.

Water, 86 to 87 per cent.; average nearer 87 per cent.

Specific Gravity, 1.030 to 1.032.

### **Breed of Cows Affect Milk**

It is well known that the fat content of milk varies in a somewhat characteristic way with the breed of cows. While there is a marked variation in cows of the same breed, there is found to be a fairly uniform difference, more or less marked, if we consider the averages of different breeds in herds. Dairymen are aware that so far as the quality is concerned, no cows yield so rich a milk as the Jersey and Guernsey cows.

The following table compiled from a large number of analyses taken of milk from six different breeds of cows, were published as a record of the work of an American Experiment Station:

# MILK

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Breed of Cows	Number of Analyses	Percentages							Daily Milk Yield lbs.
		Total Solids	Not Fat	Fat	Casein	Sugar	Ash	Nitrogen	
Jersey	238	15.40	9.80	5.61	3.91	5.15	0.743	0.618	14.07
Guernsey	112	14.60	9.47	5.12	3.61	5.11	0.753	0.570	16.00
Devon	72	13.77	9.60	4.15	3.76	5.07	0.760	0.595	12.65
Ayrshire	252	13.06	9.35	3.57	3.43	5.33	0.698	0.543	18.40
American Holderness	124	12.63	9.08	3.55	3.39	5.01	0.698	0.535	13.40
Holstein Friesian	132	12.39	9.07	3.46	3.39	4.84	0.735	0.540	22.65

The Milking Records of a London Dairy Show gave the following averages:

Breed of Cow	Total Solids	Fat
Jersey	14.65	5.02
Guernsey	14.23	4.90
Ayrshire	13.43	4.15
Short Horn	12.87	3.73

The following figures taken from the records of the New York (Geneva) Agricultural Experimental Station, represent averages of many cows of various breeds for several periods of lactation:

Breed of Cow	Per Cent. Fat			Per Cent of Water
	Highest	Lowest	Average	
Jersey	6.09	4.96	5.60	84.60
Guernsey	6.13	4.51	5.30	85.10
Devon	5.23	4.30	4.60	85.50
Short Horn	4.56	4.28	4.44	85.70
Ayrshire	4.24	3.20	3.60	87.25
American Holderness	3.92	3.49	3.73	87.35
Holstein Friesian	3.85	2.88	3.36	88.20

Still other figures, compiled by Wing, from a large number of analyses made at various American Experiment Stations, are given to show how the breed of cows influences largely the percentages of fat in milk and to a smaller degree the content of solids—not fat.

	Solids	Fat
Jersey	14.70	5.35
Guernsey	14.71	5.16
Devon	14.50	4.60
Short Horn	13.38	4.05
Ayrshire	12.61	3.66
Holstein Friesian	11.85	3.42

The variation, due to breed, included apparently not only the amount of fat and the color and melting point of the fat, but the size of the milk globules. In some breeds the milk globules are uniformly large, in others very small, and in still others both large and small globules are found.

It is generally believed that the fat content of milk is materially affected by the age of the cow, being greater at maturity and less in early life and when old. Tests made, one on cows of all ages, for a week at a time, and the other upon a single herd extending over several years, show that the age of a cow has but little influence upon the richness of its milk.

“Official” Weekly Tests of    Observation on Cornell  
Holstein-Freisian Cows    University Herd, 8 Years

Age of Cows	Average Fat		Average Fat	
	No. of Cows	Content	No. of Cows	Content
2 years	147	3.29	25	3.71
3    “	81	3.31	25	3.71
4    “	59	3.41	18	3.68
5    “	37	3.42	12	3.60
6    “	36	3.34	8	3.49
7    “	22	3.25	5	3.68
8    “	14	3.40	} 4	3.89
9    “	10	3.37		
10   “	9	3.83		
11 & 12 years	4	3.57		

### Influences of the Period of Lactation upon Cow's Milk

Cook has said that on an average, cows give the thinnest milk just after calving; it becomes slightly richer during the next two weeks and then it holds almost uniform in quality for 4 or 5 months, after

which it gradually increases in richness as the cow comes near the calving period again and by the ninth month from the last calving, it is almost one-seventh richer than it was during the earliest months. The difference in the quality of the milk is manifested almost entirely in the fat, the other solids remaining practically the same. Wing maintains that after the third or fourth week of lactation the percentage of fat in the milk remains fairly constant until the seventh or eighth month or until the quantity of milk begins to rapidly diminish, but while the percentage of fat does not change, he says that the character of the fat undergoes several marked and characteristic changes. The fatty globules are large in size during the early period of lactation and constantly diminish in size but increase in number as the period advances, the total amount of fat being practically constant. In the early period of lactation, olein represents a large proportion of the fat, possibly 50 per cent., and as the lactation progresses, the proportion of olein decreases and stearin and palmitin increase until the proportion of olein may fall as low as 20 per cent. Dean states that his experience suggests that if the lactation period of a cow be divided into three parts of three months each, there is an increase in fat content of the milk of 17 per cent. and 46 per cent., respectively, in the second and third periods over the first. This statement does not seem to be substantiated by the recorded experiences and investigations of other experts. The following data from the records of the New York (Geneva) Station are of interest:

Number of Months of Lactation	Per Cent. of Fat in Milk	Per Cent. of Water in Milk
1	4.54	86.00
2	4.33	86.50
3	4.28	86.53
4	4.39	86.36
5	4.38	86.25
6	4.53	86.00
7	4.56	85.82
8	4.66	85.67
9	4.79	85.54
10	5.00	85.17

**Variation in the Composition of Milk as Drawn from  
a Cow in the Various Stages of One Milking.**

Boussingault carried out some experiments which illustrate that there is a steady increase in the total solids during the whole period of milking. In this experiment, the milk drawn from the cow's udder was divided into six consecutive portions and analyzed:

	Time Divisions					
	1	2	3	4	5	6
Solids	10.47	10.75	10.85	11.23	11.63	12.67
Fat	1.70	1.76	2.10	2.54	3.14	4.08
Solids-not-fat	8.77	8.99	8.75	8.69	8.49	8.59

It will be seen from the above that the increase is limited to the fat.

Van Slyke conducted and recorded certain tests which also illustrate the general rule that the first milk drawn contains the least fat, and the last milk drawn, known as the "strippings," is the richest in fat.

	Per Cent. of Fat in Milk		
	Cow 1	Cow 2	Cow 3
First portion drawn	0.90	1.60	1.60
Second " "	2.60	3.20	3.25
Third " "	5.35	4.10	5.00
Fourth " "	9.80	8.10	8.30

Snyder gives some figures showing the difference between "fore milk" and "strippings" which also indicate that the casein, ash and sugar content of milk remain comparatively constant, but the fat content varies so greatly that the importance of careful and thorough milking, as well as the mixing of milk, is most evident. The composition of the first pint and the last pint from two cows are given herewith:

	Cow No. 1		Cow No. 2	
	First Pint Per Cent.	Last Pint Per Cent.	First Pint Per Cent.	Last Pint Per Cent.
Total solids	9.42	19.49	10.10	18.47
Fat	0.71	10.84	1.02	9.49
Solids—not fat	8.71	8.65	9.08	8.98
Casein, Albumen	3.44	3.51	3.35	3.65
Ash	0.68	0.72	0.70	0.74

#### **Variation of Time Between Milkings in Relation to the Milk.**

As a rule the longer the time between two successive milkings, the smaller is the fat content of the milk, and the shorter the time between milkings, the greater is the percentage of fat in the milk. When the time between milkings is uniformly equal, the variation of fat in milk is small, provided the general environment, food and health of the animal remain the same. Wing says: "Milk is richest in fat that is drawn after the shortest period, and this has been shown to be the case when cows have been milked three or four or even five times per day." This is a general rule, but, of course, there are many exceptions, and the physical condition and vitality of the cow as well as regular periods between milkings, must be considered. Aikman says that "When a cow is milked three or four times a day,

an increase in its amount to the extent of 20 per cent. and an increase in its fat to the extent of 25 per cent. may be obtained over that gained when it is only twice milked." The general practice is to milk cows twice a day, and more uniform milk is obtained if the period between milkings is kept constant.

### **Conditions Influencing the Quality of Milk**

Breed and individuality of the cow and the period of lactation are important factors influencing the quality of milk. We have also seen that the extent of milking and the periods between milkings play an important part and, moreover, the milk varies very materially in fat content, depending upon the time when it is drawn in relation to the total time involved in each separate milking. The influence of food has probably been both over and under-estimated and the modern tendency seems to rather under-estimate the effect that feeding has on milk secretion. Cows must be properly fed and be nourished with a well adjusted diet, if they are expected to yield their maximum quantity of rich milk—this is an inexorable law of nature. Insufficient or unnatural feeding is bound to impoverish the milk yield both in quality and quantity. A cow, notwithstanding her appearance of phlegmatic but kindly stoicism, is an extremely nervous animal, and biological laws suggest that her unnatural life and artificial existence in the servitude of man, would make of her a creature sensitive to environment and disease. The cow is subject to indisposition that cannot be expressed. It is influenced by climate and storms, excitement, noise and commotion, exertion and the season of

the year, etc. The normal effect of a slight feverish condition is to increase the percentage of fat and albumen in the milk; if the fever continues or grows severe the fat content of the milk falls as quickly as it had risen and to a correspondingly lower point. The proportion of albumen in milk is very largely influenced by the physical condition of the cow, and, whereas the food, if properly nourishing with ample calorific value, does not materially affect the fat and solids in milk, yet the quality and physical characteristics of the constituents in the milk and particularly of the fat, are materially influenced by the nature of the food consumed. Abnormal milk samples are frequently obtained at Fairs and Dairy Shows. A cow at a Fair amidst excitement, Aikman tells us, yielded milk with only 10.85 per cent. of total solids and 1.85 per cent. of fat, and next day when quiet and in a normal condition gave milk which showed 12.75 per cent. of total solids and 3.64 per cent. of fat. At times excitement results in abnormally good milkings; 19.5 per cent. of total solids, and 11.6 per cent. of fat have been obtained from an average good cow under the unnatural conditions prevailing at a County Fair.

#### **Colostrum Milk.**

The first milk secreted by a cow after parturition and for a short time before calving is quite distinct in composition and physical properties from that produced after the secretion has become well established. Such milk is called "colostrum" or "beastings" and is ordinarily considered unfit for consumption or manufacture. It is a turbid yellow in color, has a high specific gravity fre-

quently reaching 1.064, and has a sweet, saltish taste, a characteristic oily feeling and a viscous slimy nature with strong and peculiar odor. When boiled it coagulates on account of the large amount of albumen present and when hot water is poured into colostrum milk, it curdles. The term "colostrum" is used because of the presence in such milk of circular bodies larger than the fat globules which are known as colostrum cells. These cells resemble in appearance white blood corpuscles from which it is supposed they are derived. The colostrum cells begin to make their appearance in milk about a week before a calf is born, and they decrease materially four or five days after calving. The change is a gradual and progressive one and is more or less dependent upon the physical condition of the animal. The colostrum acts as a purge upon the young calf, and there seems to be no grounds whatever for the belief, somewhat popular, that colostrum is not suitable as a food for the young calf. Nature does not supply food unsuited to her natural offspring.

The following are several analyses of colostrum milk reported by authorities, some of them being the average results obtained from many samples tested from different cows after parturition:

		Total		Albu-			
	Water	Solids	Fat	Casein	men	Sugar	Ash
Eugling	71.69	28.31	3.37	4.83	15.85	2.48	1.78
Snyder	71.50	28.50	6.04	3.50	12.67	4.85	1.35
Richmond	72.39	27.61	1.30	23.70		1.52	1.09
Richmond	75.51	24.49	6.32	14.91		2.17	1.09

Colostrum milk should never be mixed with other milk. It prevents creaming by the gravity process and clogs the separator. It produces an

inferior butter product and causes trouble in cheese-making, as it seriously interferes with the curing and keeping qualities of the cheese. Colostrum differs from normal milk in the fact that it contains grape sugar to a very large extent, in lieu of the milk sugar of ordinary milk. It has much more ash, and nearly half of it (41.43 per cent.) consists of phosphoric acid as against about 27 per cent. in the ash of normal milk. Emmerling found globulin in colostrum to the extent of 8.3 per cent., also such bodies as lecithin, cholesterin, urea and nuclein. The fat of colostrum has a higher melting point than the fat of ordinary milk. Colostrum is not as objectionable for hygienic reasons as it is for manufacturing reasons, due to its effect upon the uniform quality of milk and its deleterious and erratic effects upon dairy products.

#### **Milk Serum.**

Milk serum consists of all the constituents of the milk except the fat, and the term *serum solids* is applied to those substances of milk which are dissolved in the water, i. e., the sugar, ash, albumen and casein taken collectively.

#### **Milk Fat.**

Milk Fat, also called Butter Fat, is not a single chemical compound, but is a mixture of a considerable number of separate and distinct fats, most of which are compounds called glycerides, each glyceride being formed by the chemical union of glycerine as a base with some acid or acids of a particular kind. The fats in milk are of two kinds, volatile and non-volatile; to the former class belong the essential oils that give to milk and its products their characteristic odor and flavor; the latter make

up about 85 per cent. of the total fat content of milk and consist of glycerides which differ from each other chiefly in their hardness or melting point. The chief normal volatile fats are butyrim, and caporin, whereas the non-volatile fats are olein, palmitin, myristin, stearin, etc. Brown gives the following percentage of fatty acids in milk:

	Per Cent.		Per Cent.
Oleic	33.95	Butyric	6.23
Palmitic	40.51	Lauric	2.73
Myristic	10.44	Caproic	2.32
Stearic	1.91	Caprylic	.53
Dioxystearic	1.04	Capric	.34

The melting point of palmitin is  $144.6^{\circ}$  F., of stearin  $123^{\circ}$  F., and of myristin  $88^{\circ}$  F. All the other fats, with the exception of caprin, are liquid at ordinary temperature, and the melting point of milk fat varies from about  $84^{\circ}$  to  $106^{\circ}$  F., depending upon the proportion of the higher or lower melting point fats therein. Milk fat contains about 12.5 per cent. of glycerin in combination with acids. Of the fat acids in butter fat, about 87.5 per cent. consist of the insoluble fat acids, while in other forms of animal fat, such as lard and beef fat, the amount of these insoluble fat-acids is considerably greater.

Duclaux has given the composition of butter fat as follows:

Stearin, palmitin, olein and traces of myristin	Per Cent.
and butin .....	91.50
Butyrim .....	4.20
Capronin .....	2.50
Caprylin, Caprinin and traces of Laurin.....	1.80
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Total .....	100.00

Myristin occurs in nutmegs; butyrin in another combination flavors pineapples and rum; caprinin is found in cocoanut fat, mutton fat, etc.; caprylin is a by-product of alcoholic fermentation and also occurs in cocoa fat; laurin is found in sweet bay; so it is evident that there are some curious relationships in flavoring materials.

Milk fat is more digestible than almost any other fat and contains minute quantities of lecithin,—a fat containing phosphorus.

### **The Albuminoids of Milk.**

There are four nitrogen-containing or protein bodies in milk, viz.: casein or caseinogen (to distinguish it from pure casein), albumen, lactoprotein—which has been called albuminose or galactine, and lactoglobulin. As the latter two are present in such small quantities, they are generally ignored, although much lactoglobulin is present in colostrum,—8 per cent. having been reported.

### **Milk Casein.**

Casein is the most important nitrogen compound in milk. It has a high food value and its presence makes it possible to convert milk into cheese. It is the chief constituent of the curd or coagulum of milk. The casein content of milk varies from about 2 to 4.5 per cent. and its composition is stated by Kirchner as follows:

Carbon	53.00	per cent.
Hydrogen	7.12	“ “
Nitrogen	15.65	“ “
Oxygen	22.60	“ “
Sulphur	.78	“ “
Phosphorus	.85	“ “
Total	100.00	“ “

In milk the protein molecule of casein is combined with calcium, or some calcium compound, and hence the proper chemical name of milk-casein is calcium-casein. It exists in milk not in solution, but in the form of extremely minute, solid, gelatinous particles in suspension or in a colloidal state. When milk sours, the lactic acid formed, acts upon the casein and the action of acids on casein is accelerated by an increase of temperature within certain limits; but heat alone, even at the boiling point of water, does not coagulate the casein in milk. The forming of a peculiar skin on the surface of milk heated above 140° F. is largely due to the casein content of the milk, although the skin itself has the chemical composition approaching evaporated milk.

#### Milk Albumen.

The albumen of milk is nearly identical with egg albumen or the "white" of the egg. Albumen and casein have about the same chemical composition, but possess different properties. Sébélien gives the composition of milk albumen or lactalbumin as:

Carbon	52.19	Per	Cent.
Hydrogen	7.18	"	"
Nitrogen	15.77	"	"
Oxygen	23.13	"	"
Sulphur	1.73	"	"
<hr/>			
Total	100.00	"	"

Albumen differs from casein in not containing phosphorus, and from the other albuminoids of milk in its sulphur content. Its average percentage in milk, according to Kirchner, is .6 of 1 per cent., its amount varying in normal milk from 0.2 to 0.8

per cent. It exists in a state of solution and is not coagulated with the casein in cheese-making, but under such circumstances, chiefly passes into the whey. When milk is heated at  $158^{\circ}$  to  $167^{\circ}$  F., the albumen is coagulated to a great extent.

The nitrogenous constituents of milk are all considered of equivalent food value and are classed as protein. The proteids are the most important constituents of food, for they build up and repair the muscles, brain, nerves, and other bodily structures.

#### **Milk Sugar.**

Milk sugar, or lactose, is characteristic of milk and is not found elsewhere. It exists in solution in the milk serum and has the same chemical composition as cane sugar. Milk sugar has very much less sweetening power than ordinary sugar and is not as soluble. It is easily decomposed by the action of bacteria and readily converted into lactic acid; it thus plays an important part indirectly in butter and cheese-making, also in lactic buttermilk and the natural souring of milk. The following is the composition of milk sugar:

Carbon	40	per cent.	Hydrogen	6.10	per cent.
Oxygen	48.9	" "	Water	5.00	" "

Milk sugar is soluble in six times its weight of water, while ordinary sugar dissolves in one-third of its weight of water. The specific gravity of milk sugar is 1.53, that of cane sugar being 1.60. The sugar of milk passes largely into the whey in cheese-making and forms over 70 per cent. of the solids in whey. The milk sugar of commerce is generally made by evaporating whey and purifying the product thus obtained.

Milk sugar does not ferment with ordinary yeast, but certain special yeasts which are used in the preparation of keffir, koumiss, etc., have the power of transforming it into alcohol.

### The Salts of Milk.

The salts of milk, despite their comparatively small proportions and generally believed insignificance, exert an influence of some importance on the nature and properties of milk. The salts of milk are generally classified under the designation "ash" and are found in the grayish white ash obtained when the milk solids are burned. Schrodt and Wiley have each given average analyses of the composition of the ash of milk, which are herewith given comparatively:

	Schrodt	Wiley
Potash	25.42	28.7
Soda	10.94	6.7
Lime	21.45	20.3
Magnesia	2.54	2.0
Ferric Oxide	0.11	4.0
Sulphuric Anhydride	4.11	
Phosphoric Anhydride	24.11	29.3
Chlorine	14.60	11.0
Carbonic Acid		1.0
	<hr/>	<hr/>
	103.28	103.0
Less oxygen as chlorine	3.28	3.0
	<hr/>	<hr/>
Total	100.00	100.0

Attempts have been made from the analyses of the ash to reconstitute the composition of the mineral matter as it exists in the milk. The best known

is that of Soldner, and the following is his calculation:

	Per Cent.
Sodium Chloride	10.62
Potassium Chloride	9.16
Monopotassium Phosphate	12.77
Dipotassium Phosphate	9.22
Potassium Citrate	5.47
Dimagnesium Citrate	3.71
Magnesium Citrate	4.05
Dicalcium Phosphate	7.42
Tricalcium Phosphate	8.90
Calcium Citrate	23.55
Calcium Oxide in combination with Casein	5.13

The ash is the least variable constituent of milk. Wing says: "It is composed chiefly of the phosphates of lime and potash, the chlorides of potash and soda, with small amounts of phosphates of iron and magnesia. It seems probable that at least a part of the phosphate of lime is ordinarily in insoluble form, suspended in the milk in very fine particles in connection with the casein." Fleischmann has given the salts in milk as:

Phosphoric Acid	28.31	Per Cent.
Chlorine	16.34	" "
Lime	27.00	" "
Potash	17.34	" "
Soda	10.00	" "
Magnesia	4.07	" "
Ferric Oxide	0.62	" "

The Chloride of Potash is largely in excess of the Chloride of Soda, which is directly opposite to the proportion of these two salts in the blood. The

salts of milk are commonly spoken of as the ash or mineral constituents. This conception is somewhat misleading because the materials appearing in the ash are, to some considerable extent, combined in organic compounds, instead of existing in the milk as separate inorganic bodies. The mineral constituents of milk have many important functions to perform in the building up and nutrition of the bodily organism.

### **The Gases of Milk.**

Milk contains more or less oxygen, nitrogen and carbon dioxide in varying amounts. The oxygen and nitrogen are carried into the milk mechanically from the air in the process of milking. Carbon dioxide is present in the udder milk, there being probably 3 or 4 per cent. by volume, a portion of which escapes in the process of milking.

### **The Food Value of Cow's Milk.**

From his own investigations and those of others, Rubner suggested the calorific value of the three prime classifications of food as follows:

1 gram of Protein	4.1 Calories
1 " " Fat	9.3 "
1 " " Carbohydrates	4.1 "

Atwater has more recently suggested a revision of these figures based on very exhaustive experiments in this country, his proposed fuel value for one gram of protein or carbohydrate being 4 calories, and for one gram of fat, 8.9 calories. Rubner's figures being still generally used, let us use them in computing the food value of a milk containing

3.6 per cent. of fat, 4.8 per cent. of milk sugar and 3.1 per cent. of nitrogenous matter:

Fat	3.6 x 9.3=33.48	Calories per 100 grams.
Milk sugar or		
Carbohydrates	4.8 x 4.1=19.68	" " " "
Nitrogenous Matter		
or Protein	3.1 x 4.1=12.71	" " " "
<hr/>		
Total	65.87	

100 grams equal 3.53 oz. or 453 grams equal 1 pound; therefore  $65.87 \times 4.53 = 298.4$  calories per pound.

The following table has been taken from various published reports giving the composition and food value of liquid dairy products:

#### COMPOSITION AND NOURISHMENT OF DAIRY PRODUCTS

Dairy Products, Etc.	Water	Protein	Fat	Carbo-Hydrates	Ash	Fuel Value
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Calories Per Pound
Whole Milk	87.0	3.3	4.0	5.0	.7	325
Skimmed Milk	90.5	3.4	.3	5.1	.7	170
Cream	74.0	2.5	18.5	4.5	.5	910
Buttermilk	91.0	3.0	.5	4.8	.7	165
Condensed Milk	26.9	8.8	8.3	54.1	1.9	1,520
Evaporated Cream	68.2	9.6	9.3	11.2	1.7	780
Koumiss	89.3	2.8	2.1	5.4	.4	240
Whey	93.0	1.0	.3	5.0	.7	125

#### Cream.

Cream is the oily and fatty part of the milk which rises to the surface when the milk stands unagitated and it is characterized by containing a higher percentage of fat than milk. Cream is separated

from milk, either naturally, due to the differences in the specific gravity of fat globules and milk-serum, or mechanically by centrifugal separators, to be consumed as food or used in the manufacture of butter. The separation of cream from milk is always accompanied with some loss of fat. Wing says that "Cream of good quality should contain from 18 to 25 per cent. of fat, and very rich cream contains from 35 to 40 per cent. of fat." Snyder gives the composition of good average cream as:

Water	66.41 Per Cent.
Solids	33.59 " "
Fat	25.72 " "
Casein and Albumen	3.70 " "
Milk sugar	3.54 " "
Ash	0.63 " "

Cream is spoken of as thick, medium or thin, according to its fat content; thin cream contains 10 to 20 per cent., medium 20 to 30, thick 30 to 40 and very thick over 40 per cent.; very thin cream may contain as low as 8 per cent. of fat. Locke has prepared some figures giving the relative food value of various grades of cream:

Nature of Cream	Weight grams	Per-centage of Water	Protein	Calories		Total	Calories per 100 grams
				Fat	Carbo-hydrates		
Average	20	66.4	3.0	47.8	2.9	54	269
Heavy	20	58.3	1.8	67.4	2.4	72	358
Thick	20	39.3	1.3	104.3	1.9	108	540
Whipped	30	59.7	4.6	71.8	4.3	81	269

Cream is adulterated by the addition of milk, coloring matter, preservatives, such as formalin, boric acid and salicylic acid, and foreign matter, such as viscogin added to give a higher viscosity. Cream of low fat content is a very frequently practiced form of fraud.

**Condensed Milk.**

Many attempts have been made in the past to convert milk into some form in which it will keep for long periods of time without undergoing decomposition, and these attempts have all taken the form of preparing milk in a condensed or concentrated form. At first attempts were made to "preserve" or condense milk by evaporating milk to dryness, and the solids left behind were mixed with a small quantity of soda and pressed into cakes. These milk cakes did not prove satisfactory, however, for they did not keep well; the fat became rancid and the cakes would not dissolve properly in water, due to the drying process having destroyed the colloidal condition of the casein matter. It was later found that evaporating the milk to one-half or one-third of its original volume, produced a condensed milk which would keep fairly well, and that the addition of sugar to such evaporated milk still further increased its keeping properties. The composition of condensed milk is determined by the character of the fresh milk. If the fresh milk, for instance, contains a large percentage of fat, the condensed product will show a predominance of that constituent. Condensed milk has been made of whole milk, natural and sweetened, and skim milk, sweetened and unsweetened, but the last form does not appear to be on the market at present.

Sohn gives the composition of British commercial condensed milk as follows:

	Whole Milk Sweetened Per Cent.	Whole Milk Unsweetened Per Cent.	Skimmed Milk Sweetened Per Cent.
Cane sugar	30 to 57	none	30 to 55
Milk sugar	13 to 17	16 to 18	12 to 18
Fat	10 to 13	9.5 to 12.5	0.2 to 1.3
Protein (Albumen and Casein)	8 to 12	8 to 14.5	7.5 to 12.5

Huebner gives the following analyses of sweetened and unsweetened condensed milk:

	Water	Fat	Protein	Milk Sugar	Cane Sugar	Ash
<i>Sweetened</i>						
Norwegian	28.85	9.21	8.98	14.14	36.74	2.08
Nestles' Swiss	15.30	8.85	9.98	13.62	50.08	2.17
<i>Unsweetened</i>						
American (mean of 10 varieties)	45.59	15.67	17.81	15.40	.....	2.53

The Borden original patent granted in 1856 was on a process "for concentrating sweet milk by evaporation in vacuo, having no sugar or other foreign matter mixed with it." To-day sweetened condensed milk is more generally used and it reaches the retail market in hermetically sealed cans. It is made from fresh cow's milk heated to near the boiling point and sucrose (cane sugar) added. The milk and sugar solution is then condensed in vacuo at a temperature of 130° to 150° F. The ratio of concentration is about 2.5 to 1, and the finished product contains about 40 per cent. of cane sugar, is of semi-liquid consistency and has a specific gravity of about 1.29. Sweetened condensed milk is not effectively sterilized, although it is much freer from bacteria than ordinary milk. No tubercle bacilli have been found

in it and "it is almost invariably free from pathogenic germs in general." Sweetened condensed milk is well preserved by the cane sugar it contains; it will keep for a considerable length of time, but is best when fresh and should be used promptly when the container can is opened. In undiluted condensed milk, micro-organisms do not grow readily, but when water is added they multiply with extraordinary rapidity.

Unsweetened condensed whole milk is generally termed "evaporated" milk. It is prepared in a somewhat similar manner to sweetened condensed milk, with the exception that no cane sugar is added and the rate of concentration is made about  $2\frac{1}{4}$  to 1. The hermetically sealed cans of evaporated milk are sterilized at temperatures ranging from  $225^{\circ}$  to  $240^{\circ}$  F. for from half an hour to one hour. From the sterilizer, the cans are transferred to a shaker, where they are subjected to violent agitation to break up the coagulum which may have formed during sterilization. The finished product has the consistency of cream of medium richness and has a specific gravity of about 1.065. Being sterile it will keep indefinitely, but like all other such products, is best when fresh. What is known as "Plain Condensed Bulk Milk" is made from whole milk partly skimmed or from skimmed milk. The fresh milk is generally heated to about  $160^{\circ}$  F. and condensed in vacuo at  $125^{\circ}$  to  $150^{\circ}$  F., the ratio of concentration being 3 or 4 to 1. Before leaving the vacuum pan, it is superheated by steam to swell or thicken it. It is usually sold in very large milk cans to large consumers, such as ice-cream manufacturers, and only very limited quantities of it are retailed to domestic consumers. Such milk has

the consistency of very thick cream and a specific gravity of about 1.09. It is not sterile and its keeping properties are similar to those of a good grade of pasteurized milk.

What is known in our country as "Concentrated milk" of the unsweetened condensed variety is only made to a very limited extent. It is produced from fresh skim milk condensed at 140° F. by blowing hot air through the milk. The ratio of concentration is about 3 to 1. It is not sterile, has a low fat content, and keeps about as long as pasteurized milk. Prof. Conn believes that concentrated milk produced by a new patented process which withdraws much of the water from skim milk and subsequently remixes the product with pasteurized cream in proper proportion, offers some exceptional advantages. The product resembles cream and "when the proper amount of water is mixed with this concentrated milk in the proportion of 3 to 1, it is restored to its original condition so closely as to be almost indistinguishable from fresh milk. It tastes the same, it curdles with rennet, cream rises upon it in much the same way as on fresh milk and, so far as experimental tests have determined, its digestibility is not impaired. Its treatment at a temperature of 140° F. for two hours, destroys all disease germs. If kept at a temperature below 50° F. it will not only keep sweet for 6 to 8 days, but at the end of that time the number of bacteria will be surprisingly few. During the first few days after its preparation, it is possible to transport such milk for long distances and yet place it on sale in a city in a better condition, at least so far as bacteria are concerned, than most of the milk which now reaches the larger markets, and the expense

of transportation is very much reduced." Prof. Conn feels that concentrated milk, properly made by this modern process, promises great aid in solving the milk problem of cities, since it offers at a low price milk that he affirms cannot be distinguished from ordinary milk, and yet can be guaranteed as free from pathogenic bacteria; and it will keep well. Concentrated milk with pasteurized cream added, and with well proportioned fat content, is, of course, a very different commodity from the usual concentrated milk made from skimmed milk, i. e., robbed of its fat. It must be comparable with and is essentially similar to pasteurized whole milk, its prime advantage being in the elimination of much water and the economic benefits that may ensue from such concentration of a food commodity.

The success of every form of condensed milk depends primarily on the use by the manufacturer of a good quality of fresh milk, coupled, of course, with cleanliness and care in the manipulation of it. Wing says: "Milk that is abnormal in its properties when drawn, badly contaminated milk, and milk that has not been properly and promptly cooled on the farm, cannot be safely used in the condensery. Such milk either does not withstand the trials of the process or it succumbs to the many and unfavorable conditions to which it is subjected on its long journey from the factory to the pantry of the consumer. Its original defects magnify with age and follow it to its destination." Dr. Wiley has published the following analyses of four different brands of evaporated or unsweetened condensed milk, and two brands of sweetened condensed milk, to show the present typical composition of such products in the American market.

## (A) EVAPORATED OR UNSWEETENED CONDENSED MILKS

Constituents	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Water	72.03	70.26	72.17	71.34
Fat	8.42	8.97	8.09	8.18
Proteins	7.10	7.83	7.25	7.29
Ash	1.68	1.44	1.67	1.59
Milk Sugar	10.77	10.85	10.82	10.83
Undetermined		0.65		0.77
	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00
Total Solids	27.97	29.74	27.83	28.66
Fat in Solids	30.10	30.09	29.07	28.58

## (B.) SWEETENED CONDENSED MILKS

Constituents	Per Cent.	Per Cent.
Water	26.87	24.90
Fat	9.82	10.30
Proteins	8.04	8.77
Milk Sugar	11.11	11.18
Cane Sugar	42.22	42.12
Ash	1.92	1.85
Undetermined		0.88
	<hr/> 100.00	<hr/> 100.00
Total Solids	73.13	75.10
Milk Solids	30.91	32.98
Fat in Milk Solids	31.77	31.23

The ratio of proteins to fat is from 1.12 to 1.18 to 1 for unsweetened condensed milks and 1.17 to 1.22 to 1 for sweetened condensed milks. The Federal standard for condensed and evaporated milks requires that such milk shall have 28 per cent. of milk solids (the above analyses show 27.83 to 32.98 per cent.) of which not less than 27.5 per cent. is milk fat—the above analyses show 28.58

to 31.77 per cent. Wiley says: "An important factor in regard to the purchasing of condensed milk is found in the fact that it does not always have a uniform density. The national standard for condensed milk requires that it shall contain not less than 28 per cent. of solid matter, *while many of the milks found upon the market contain decidedly less than this amount.* To the poor man especially who buys his condensed milk at a high price, it is of some importance to know whether he gets a sufficiently condensed article, or whether he is buying a large amount of water." The same general statement applies to ordinary fresh milk, and practically to all articles of food and commerce. The water content of almost every article purchased, except dense metals and kindred commodities, should be known, for water is cheap; it is used very extensively and deliberately to deceive and at times it exists to confuse both the honest dealer and the intelligent consumer. Water is a necessary and valuable commodity, but to pay many cents and, at times, even dollars per pound for it (which has been done of late in the case of expensive chemicals) is not only extravagant but a reflection upon the economic judgment and good sense of a people.

In sweetened condensed milk, the large amount of sugar present, detrimentally affects the value of the product as a well balanced wholesome food. For this reason, even if condensed milk is useful for certain purposes, it can never be widely substituted for fresh milk in an ordinary diet. It has undoubtedly a place in our food products, but it cannot take the place of fresh milk for all or even the majority of purposes. Unsweetened condensed milk has the advantages and disadvantages of ster-

ilized milk, which we will discuss later, and while an article of value for some purposes, it adds little to the solution of our milk problem to-day. The preservation of sweetened condensed milk is due to its great sugar content, which prevents the growth of bacteria; but sugar will not prevent the growth of yeasts. H. W. Conn says: "While bacteria do not usually spoil condensed milk, it is sometimes found, to the misfortune of the manufacturer, that yeasts may ferment it. Immense losses have occurred in the condensed milk industry in the last few years by the growth of fermenting yeasts. **Bacteria** can usually be found in condensed milk also, but they do not develop. Hence, if yeasts do not produce trouble, the material keeps well for a long time."

Dr. Holt has advised the use of condensed milk for babies over three months old who, being deprived of the breast, in spite of all variations made in fresh cow's milk, continue to have symptoms of indigestion and do not thrive. He believes that a good brand of condensed milk will be more apt to agree with the child for a limited period if it has experienced intestinal trouble, such as colic, flatulence, curds, constipation or diarrhœa, rather than gastric trouble, such as vomiting, regurgitation, etc. Holt advises dilution with boiled water or barley water 16 to 1, reducing to 8 to 1 for older children, and states: "In most cases it should be used as the sole food for a few weeks only," and adds: "Condensed milk is not to be recommended as a *permanent* food where good fresh cow's milk can be obtained." Holt also states that condensed milk prepared as a child's food is very low in fats and proteids and high in sugar. This accounts for

its apparent ease of digestibility and also explains why children reared entirely upon it often gain very rapidly in weight, yet have, as a rule, but little resistance. Such children "are very prone to develop rickets and sometimes scurvy." Moreover, most of the proprietary infant foods, such as substitutes for milk, are open to the same objection. Pritchard maintains that fresh milk is the thing to be desired in all cases for infants, and the more milk is manipulated the more it loses some subtle virtue, such loss being due primarily to the destruction of certain proteolytic and fat splitting ferments. He does not attach any value whatever to dried or condensed milk as a food for babies, and if the fat in the milk has been reduced, he advises the use of cod liver oil emulsion or pure olive oil. Condensed milk to be good should be made from healthy cows, the product of sanitary dairies, and if it is to be used for the food of infants, it should be produced from a certified fresh milk. Wiley has said that while it is idle to claim that even the best possible condensed milk is as good for a child as pure fresh milk, yet he feels that such a product would be preferable to the indiscriminate milk supplies of many of our cities. "In fact, for congested centers where it is difficult to secure *fresh* milk, I think no one would doubt that a properly manufactured condensed milk would be a most helpful substitute. It could be more easily transported and delivered to congested centers than could fresh milk. If possible, perfectly fresh milk should always be secured, but such possibilities do not offer themselves to the poorer residents of large and densely populated cities, and hence it seems to me that a properly certified and sterilized con-

densed milk would prove a blessing under such circumstances."

### Evaporated Cream

This product consists of milk with a varying amount of cream evaporated to less than half its bulk and sterilized by heat; it is sealed in cans and should keep almost indefinitely. Like unsweetened condensed milk, it has the advantages and disadvantages of sterilized milk, and while it may have its place among food products, it cannot replace raw milk as an article of food.

### Milk Powder

Several processes for completely removing the water from milk have been devised and put in more or less successful operation. When milk is reduced to a powder, it is capable of being kept a relatively long time. When the milk used contains the natural cream, the powder produced will gradually become rancid, but powdered skim milk can be kept without much trouble, and it is used by confectioners, bakers, manufacturers of chocolate, custards, etc. For purposes of transportation, the milk powder, or dried milk, has advantages over all other forms of milk. Sohn gives the following data of the composition of dried or powdered whole milk and skimmed milk:

	Dried Whole Milk	Dried Skimmed Milk
Water	4 to 6 per cent.	4 to 6 per cent.
Fat	25 to 30 " "	1 to 1½ " "
Protein	24 to 26 " "	32 to 35 " "
Milk Sugar	30 to 35 " "	45 to 50 " "
Mineral Salts	5 to 6 " "	7 to 8 " "

Sohn says that the milk powder made from whole milk should be diluted with 6½ parts of water and

the skimmed milk powder with 10 parts of water, and whereas the former could be used as an infant food in place of condensed milk, the latter should never be used for such purposes. This is self-evident, because of the low fat content of dried skimmed milk. It is a difficult matter to rob milk of all its moisture in such a way that no part of the soluble substance in the milk becomes coagulated in drying and so that when water is added, the milk solids will resume their original physical state and restore the milk to a homogeneous fluid with all its original properties and taste.

### **Frozen Milk**

Hittcher tells us that a method of meeting the milk problem by freezing the milk into cakes and pressing it in forms of bricks has been adopted in some localities in Europe. The difficulty of its success has been in part that the freezing changes somewhat the character of the milk and experience to date does not suggest that this process is sufficiently meritorious to warrant extensive adoption.

### **The Bacteriology of Milk**

Bacteria were known to the Dutch Microscopist Leeuwenhoek in the seventeenth century. About seventy-five years ago it was suggested that the presence and activity of micro-organisms influenced or produced certain unusual phenomena. Pasteur, twenty years later, showed a close connection between microscopic life and the souring of milk; and during the past three decades, the importance of bacteriology in relation to milk has become so great that it has revolutionized all dairy methods "from the cow to the consumer's table." The knowledge

gained has proved to be of economic benefit to the dairyman, but above all it has helped the consumer by the creation of hygienic and sanitary conditions which naturally tend to safeguard the health and lives of the great consuming public. It is said that the presence of bacteria is well-nigh universal, existing in the air, soil and water, but it should also be noted that in uninhabited spaces their number is enormously less than in inhabited spaces; that under certain circumstances air may be, if not absolutely, yet relatively free of them; that above the sea far from land and on the mountain tops, the air is generally pure and practically sterile and that the propensity of such micro-organisms, microbes, bacilli or bacteria is to obey the law of gravity and to subside from the air, a tendency which can only be completely realized when the air is kept absolutely undisturbed—an almost impossible condition. It has been said that bacteria are present in the air above the streets of Paris to the extent of 4000 per cubic meter; this is equivalent to 1 bacterium per 15 cubic inches. A British investigator has found two bacteria per cubic inch in the air of a cow barn or thirty times as many as exist immediately over the thoroughfares of a large city. Bacteria are very abundant in the litter, manure and dirt on the floor of cow stalls and whenever such matter is stirred or disturbed, large numbers of micro-organisms are sent into the air. It is for this reason as well as the condition of the cow, attendants, milkers and milk vessels and the purity of the water used for cleaning the pails, etc., that milk is so liable to be contaminated with bacterial life. Milk as formed in a healthy cow's udder is sterile, but no matter what elaborate precautions are taken, the many attempts

to obtain sterile milk in a milk pail have failed and we are compelled to recognize as inevitable the presence of certain bacteria in milk.

### **Size, Form and Multiplication of Bacteria**

The most striking fact about bacteria is their minuteness. Conn says, "When we hear of 100,000,000 in a single drop of milk we are apt to be incredulous. A space the size of a pin head may hold 8,000,000 and 100,000,000 will have plenty of room in a drop of milk. The only way we can deal with them is to handle masses. The unit with which the student works is not a bacterium, but a colony composed of thousands of bacteria all of which are supposed to have risen from a single bacterium by multiplication."

Bacteria are extremely minute bodies, the smallest known living things, and each consists of a single cell filled with protoplasm. They are of three general forms:

1. Spherical—coccus
2. Rod or cylindrical—bacillus
3. Spiral, curved or wavy—spirillum

The latter type is very rare in milk. Some bacteria are motile, being capable of an active swimming, spinning or spiral motion while others are stationary. They reproduce generally by fission and multiply with almost inconceivable rapidity; but some produce spores and this type does not multiply, as one individual simply produces another of its kind and dies in the process. The majority of the species of bacteria (and there are thousands of them), elongate somewhat in the direction of their longer axis, a partition forms across the cell transversely and two individuals exist where there was but one. Each new bacterium then elongates

and breaks and thus by continued division the numbers increase. As such bacteria multiply in geometric progression and as a single germ may divide, under favorable conditions of food, temperature and environment, once every half hour, it is apparent that one bacterium would increase to 281,474,976,710,656 within 24 hours if the favorable conditions continued. This means that if there were no interruptions and no deaths, one bacterium in a large can of milk might multiply in 24 hours so that each one cubic centimeter of milk would contain over 7,438,000,000 bacteria. It must, of course, be readily recognized that bacteria do not long continue to multiply at this rate, for if they did, in a few days there would be no room in the world for anything else but bacteria. As Prof. Conn says, "Their multiplication is constantly being checked by adverse conditions—lack of food, lack of moisture, etc.—and thus they do not on the whole very materially increase in numbers. But this inconceivable power of multiplication they do possess and whenever they are placed for a few hours under conditions where they can have plenty of food and moisture for growth, they will develop with enormous rapidity, thus producing most profound changes in the substance upon which they are feeding."

Milk is a food drink, a liquid laden with nourishment and it is therefore an ideal breeding ground for almost any form of micro-organism that finds its way into it. If milk were a transparent fluid, the enormous growth of bacteria found in old market milk would be plainly visible to the eye, and if a similar growth occurred in clear drinks and substances, we would regard them as unfit for use on account of the visible evidences of fermentation

and putrefactive changes. Bacteria affect most profoundly the physical and chemical nature of milk and Dairy Bacteriology has done much, by the scientific study of these phenomena, to safeguard health and also on the economic side of the subject, to benefit the industry by showing how reliable and satisfactory products can be obtained.

Ordinary bacteria readily succumb to moderate heat, a temperature of  $160^{\circ}$  F. being sufficient to kill almost all of them. There is, however, as before mentioned, a type of micro-organism that does not divide and multiply but produces a spore or oval body in its centre and dies as the new form takes life—a mere form of substitution. These spores, however, are covered with a hard case which enables them to resist the extreme conditions in which the more active and multiplying forms of bacteria cannot live. Spores can be dried for months and still retain their vitality. As spore-producing bacteria are not prolific, nature apparently has made it extremely difficult for the spores to be destroyed. They will stand very much more abuse than the mature bacteria and some of the spores can be kept in a fluid at boiling temperature for long periods of time, without having their vitality destroyed, and if the medium is subsequently cooled, the spores are capable of generating and developing into bacteria. Pictet found that the spores of certain bacteria were able to survive in frozen oxygen at a temperature of  $-353^{\circ}$  F., while a few resisted a dry heat at  $302^{\circ}$  F. Milk contains many kinds of bacteria. If it is heated to about  $140^{\circ}$  to  $160^{\circ}$  F. for a certain period of time, the vast majority of the bacteria will be destroyed, but the few spores that may chance to be in the milk will not be

killed and may subsequently develop. Milk containing spore-producing bacteria cannot be sterilized by boiling and as it practically always does contain them, though to a limited extent, boiling is not sufficient to sterilize milk.

Micro-organisms of the yeast family, which multiply by budding and separation, are also found in milk. Bacteria cause decay, putrefaction and lactic acid fermentation, but yeasts are more commonly associated with the alcoholic fermentation and operate on the sugars.

### Effect of Environment on Bacteria

Nearly all forms of bacteria are sensitive to conditions of temperature. The range of temperatures in which they thrive best is rather narrow, but there is considerable range above or below, in which they will still grow and develop. For each type of micro-organism there is a *minimum* temperature, the lowest at which they will all grow; an *optimum* temperature at which they will all develop and propagate most rapidly, and a *fatal* temperature which will kill them. The range between the minimum and the fatal temperatures traverses from the impotent, dormant and inhibitory conditions, at a comparatively low temperature, up with increasing fertility and development to the maximum point of proliferation—the optimum temperature—and continuing upward, virility and reproduction or multiplication gradually wane until the temperature is reached which kills the organism. We are told that some species will grow, though slowly, at temperatures just above freezing; others require about body heat and still others seem to demand temperatures as high as 125° F. Gen-

erally speaking, it does not appear that bacteria as found in milk develop much below  $40^{\circ}$  F. or over  $125^{\circ}$  F. and by cooling milk to  $40^{\circ}$  or  $45^{\circ}$  F. bacterial development is generally effectively suspended. Some bacteria experience their peculiar favorable optimum temperature at  $60^{\circ}$ , others at  $130^{\circ}$ , but by far the larger number of bacteria find their optimum point between  $70^{\circ}$  and  $100^{\circ}$  F., a fact which explains the rapidity of the souring of milk in hot weather and the quickness with which any organic matter decays during the summer.

The following illustration will show the effect of temperature upon bacterial numbers. Conn says that a sample of milk was examined for bacteria when fresh and was found to contain 6,525 per c.c. It was then divided into two parts, one preserved at  $50^{\circ}$  F. and the other at  $70^{\circ}$  F. After 25 hours the sample that had been maintained at  $50^{\circ}$  F. showed 6,425 bacteria per c.c., or the same as when first tested, but the second sample that had been subjected to an increased temperature of only  $20^{\circ}$  F. showed a bacterial content of 6,275,000, or almost a thousand times as much. A sample of milk kept four days in a cold keeping box, showed only 10,000 bacteria per c.c., but the same milk taken from the cold room and left in the kitchen for six hours, showed 1,000,000 or an increase of 100 fold. Miquel found that milk after being kept 15 hours at a temperature of  $59^{\circ}$  F. had 100,000 bacteria per c.c., after 15 hours at  $77^{\circ}$  F. (an increase of  $18^{\circ}$  F.) the bacterial content per c.c. was 72,000,000. The table below by Conn gives the numbers of bacteria per c.c. in milk kept at different temperatures; the result of the increase in bacteria being primarily the production of lactic acid evidenced by souring.

Test	Number at Outset	In 12 Hours at 50° F.	In 12 Hours at 70° F.	In 50 Hours at 50° F.
A	46,000	39,000	249,500	1,500,000
B	47,000	44,800	360,000	127,500
C	50,000	35,000	800,000	160,000

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Test Cont'd	In 50 Hours or at Time of Curdling at 70° F.	No. of Hours to Curdle at 50° F.	No. of Hours to Curdle at 70° F.
A	542,000,000	190	56
B	792,000,000 in 36 Hours	289	36
C	2,560,000,000 in 42 Hours	172	42

Above 100° F. we are told that most bacteria are injured and as the temperature increases, more and more bacteria succumb to the fatal temperature, although the spores survive, together with some very few bacteria that have an optimum temperature of 140° or higher. In ordinary milk practically all the active bacteria are killed, if subjected to a temperature of about 145° F. for 20 minutes, therefore such a temperature should be the one adopted for "pasteurizing." A total destruction of bacteria in milk and its absolute sterilization is an extremely difficult matter and could possibly best be accomplished by several heatings to a high temperature sufficient to destroy adult germ life, with alternate coolings, thus giving the almost indestructible spores an opportunity to mature at the lower temperature in order to kill them as mature organisms at the higher temperature before new spores are created. Such intermittent sterilization would be a troublesome system to adopt for general use and it is fortunate that pathogenic germs are comparatively easily killed. Heat will destroy all bacteria, i. e., there is a fatal temperature for every species of bacteria, but cold will not exterminate them. Some

may be killed by freezing but no matter how low the temperature, some seem to survive and many micro-organisms are totally resistant to cold.

Many types of bacteria grow only in the presence of air (aerobic), other types grow only in the absence of oxygen (anaerobic), and there are still others that will grow with or without oxygen (facultative anaerobic); the common lactic acid bacterium, well known as the medium responsible for the souring of milk, belongs to this latter class. Bacteria, like higher organisms, have their preference in regard to food, although they feed upon a greater variety of substances than possibly any other organisms. Like all other forms of life, they must have nutriment in order to grow and develop, and for their sustenance, they generally require carbon, hydrogen, oxygen and nitrogen, together with small amounts of mineral matter. Bacteria feed with great readiness upon protein foods and only rarely upon carbohydrates, although the lactic acid bacterium acts upon milk sugar and causes the milk to sour. Of all the media for the abode and development of bacteria, milk is the best and hence as Aikman says, "it has become the happy hunting ground for so many of them." Conn says, "In the case of most bacteria, the organisms are unable to feed upon the material while it is alive but after it is dead they feed upon it readily and cause it to putrefy." Bacteria feeding upon living animals and plants are called parasites; those feeding upon dead animals and plants, saprophytes. By far the larger number of bacteria perform a very useful and beneficial service by transforming dead organic matter into its original condition, thus acting as nature's ordained scavengers. Bacteria need moisture for

their general growth. They flourish most when there is 90 to 100 per cent. of water, and as materials dry, bacteria generally cease to grow or thrive in them. This explains why certain dried foods will keep indefinitely. Drying, however, will not absolutely kill bacteria, for they may remain alive in such an environment for days, months and even years; they do not multiply, however; the weaker ones die, but when restored to water and a favorable temperature the survivors resume life and some again become prolific.

### **Relation of Milk Bacteria to the Human System**

Fortunately we know that the mere presence of bacteria in milk is not alarming and we also know that disease is due to agencies and conditions other than merely the presence of large numbers of bacteria. By universal consent, milk containing excessive numbers of bacteria is branded as positively unfit for infant feeding. Children are very susceptible to bacteria and their products and a very large proportion of the summer complaints of children can be attributed to the use of bacteria-laden milk. As a person grows older the body develops greater powers of resistance or apparent, comparative immunity, but we should also remember that usually a person drinks less milk in maturity than in childhood. The bacterial content of so-called fresh milk is an index of its age, cleanliness and the care it has received in handling. A knowledge of the number of bacteria in milk, of itself, is not so important from a health standpoint, as the kind and nature of bacterial products; but with cleanliness, hygienic surroundings and refrigeration the total number of bacteria can be kept low, thus

affording a mode of protection against the dangerous species and their toxic products. Milk with an extremely low bacterial content, will contain but few, if any, harmful ones. Milk with an unusually high bacterial content is a "danger flag" of health, for it is apt to suggest dirt and foulness obtained under poor sanitary dairy conditions and then recklessly subjected to a temperature, in storage or transit, conducive to the growth of most of the forms of bacteria which have entered the milk, due to prevailing conditions of ignorance or indifference. This sort of a mental attitude on the part of any dairyman or farmer suggests apathy or carelessness with regard to purity of water supply, personal cleanliness, health of operatives assigned to milking, physical condition of cows, protection from infectious diseases and possibility of spreading infection through the fertile medium of milk.

### **Tuberculosis**

There are no harmful germs found in milk from healthy cows, but sick or diseased cows may at times transmit disease through their milk, although fortunately most diseases that attack cows do not usually affect man. The cow, classified as a domestic animal, is living an unnatural life and nature demands the penalty. Cows are particularly prone to tuberculosis just as the barbarian and so-called uncivilized branches of the human race succumb to its ravages when an indoor, congested and artificial mode of life, classed as civilized, is substituted for the natural life of the free and the open. It is said that in certain parts of Denmark and Germany forty to fifty per cent. of the cattle are tubercular; in cold climates where the cattle are kept

housed most of the time, the disease is more prevalent than in warm countries where they can live a more natural outdoor life. Dr. Mohler reported in 1907 that of 1,147 recently tested cows supplying milk to the city of Washington, D. C., 214 or 18.6 per cent. were tubercular. He stated that he did not consider this a fair estimate of the extent of tuberculosis in the dairy herds supplying Washington with milk, for the tests were *only applied to those herds which had recently been cleansed by private tests or appeared so healthy that their owners had no fear of having them tested.*

The following table prepared by Salmon of the Bureau of Animal Industry, showing the results of the tuberculin test of cattle in some States, is of value as it clearly shows the wide distribution of bovine tuberculosis. As many of these herds tested were suspected herds, it is possible that some of these particular results are as much above a true general average of tubercular cattle, as the Washington tests were below:

State	Number tested	Number tuberculous	Per Cent. tuberculous
Massachusetts	24,685	12,443	50.0
Connecticut	6,300		14.2
New York, 1897-98	1,200	163	18.4
Pennsylvania	34,000	4,800	14.1
New Jersey	2,500		21.4
Illinois, 1899	3,655	560	15.3
Michigan			13.0
Iowa	873	122	13.8
Wisconsin:			
Experiment station tests—			
Suspected herds	323	115	35.6
State veterinarian's tests—			
Suspected herds	588	191	32.5



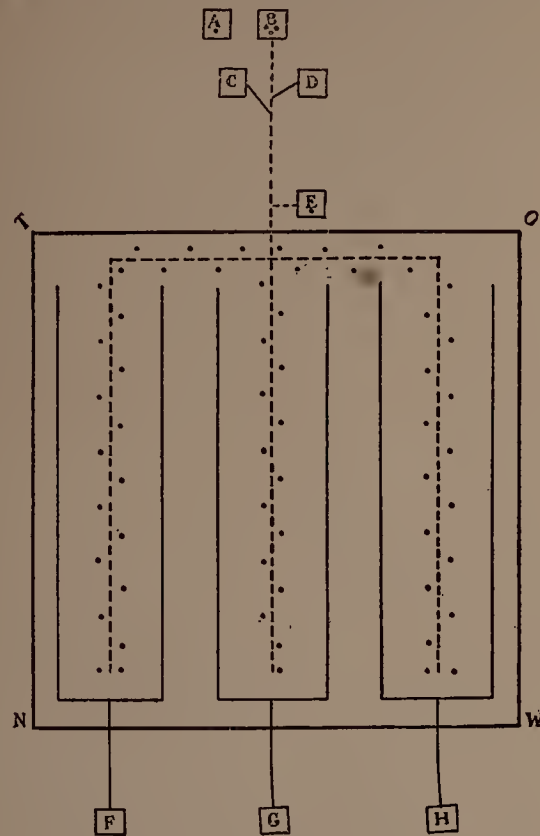
# Typhoid Epidemic

Elkton, Md.

Oct. 1900. Population 2,542

39 cases, all of which, i.e., 100 per cent, obtained Milk from a certain one of the 4 available sources of supply. Typhoid on the farm, with one son milking and the Mother handling the milk—both when ailing, caused the infection of the milk.

Showing Relation of Milk Routes to Typhoid Fever Cases at Elkton, Md., 1900



Each dot represents a case of typhoid fever.

A—Farm where original case occurred in September and was nursed by wife of farmer B.

B—Dairy farm where wife nursed preceding case and prepared the milk for market. She and one son were ailing for some days but did not stop work until October 8.

The dash-lines represent the course and distribution of the milk from farm B. All the cases of typhoid were on this milk route.

C and D were farms selling milk to farmer B. No typhoid occurred on these 2 farms.

E—Farm receiving a small amount of milk daily from B for use of girl staying at farm. This girl contracted typhoid.

F, G, and H—The 3 other dairy farms supplying milk to Elkton. The solid lines represent their routes. No case of typhoid on these routes.

The large square—"TOWN"—represents the town of Elkton.

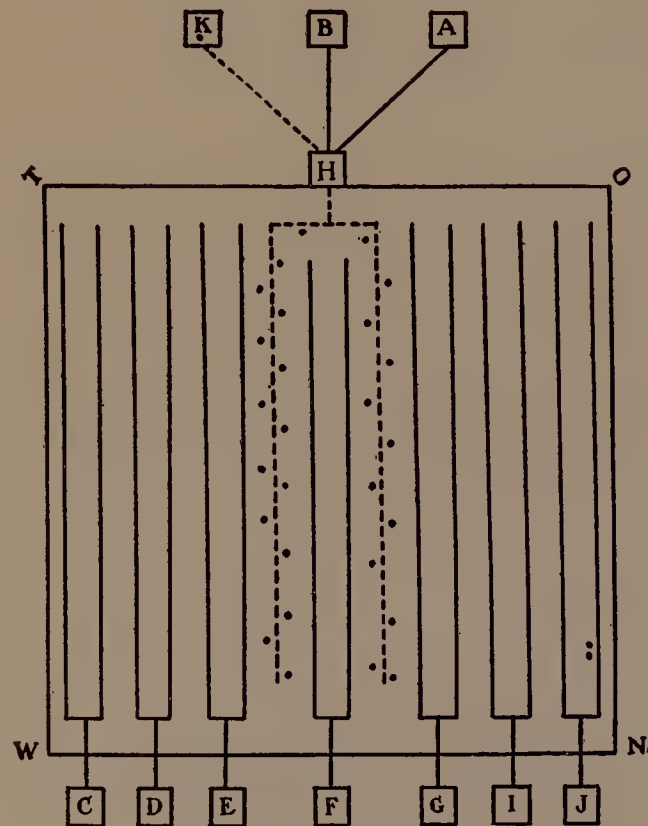
# Scarlet Fever Epidemic

Norwalk, Conn.

Nov., 1897

29 cases reported, 27 of which or 93.1 per cent received their Milk from one dealer who in turn purchased from 3 sources. At one of the farms a case of scarlet fever was discovered which infected the Milk.

Showing relation of Milk Routes to Scarlet Fever cases during outbreak at Norwalk, Conn., 1897



A, B, and K are dairy farms selling their product to retail milk dealer H. K is the farm on which a case of scarlet fever occurred antedating the outbreak in Norwalk.

The large square TOWN represents the city of Norwalk.

H is the retail milk dealer among whose customers all cases but two occurred. The dash lines represent H's milk route, and each dot is a case of scarlet fever.

C, D, E, F, G, I, and J are other dairymen having routes in Norwalk. The lines extending from them into the city represent their milk routes and are introduced to show their freedom from the disease

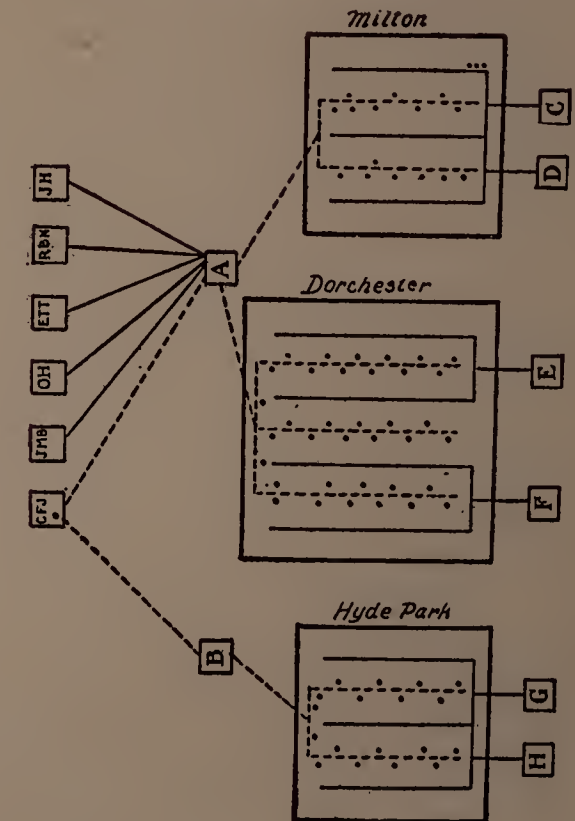
# Outbreak of Diphtheria

In Dorchester, Milton and Hyde Park, Mass.

April 11-19, 1907

72 cases reported, 69 of which or 95.8 per cent received their milk from the same source. It was found that on the farm a child had been seized with the disease on April 11 and that the cooler in which the milk was mixed was washed in the farm house by the attendant of the sick child.

Showing relation of milk routes to Diphtheria cases during the outbreak at Dorchester, Milton, and Hyde Park, 1907



J H, R B N, E T T, O H, J M B, and C F J are the farmers producing milk.

A is the milk dealer delivering milk in both Milton and Dorchester. B is the milk dealer delivering milk in Hyde Park.

The lines connecting the producing farms and the milk dealers show to which dairy the farmer sold his milk.

The large squares represent Milton, Dorchester, and Hyde Park.

The dash-lines extending from A to B into the towns represent the milk routes carrying the supposedly infectious milk.

Each dot represents a case of diphtheria and is placed on the milk route from which it was supplied.

C, D, E, F, G, and H represent the other dairies selling milk. The lines extending from them into the towns represent their routes and are inserted to show their freedom from diphtheria cases.

Hess found that of 107 average samples of raw milk obtained in New York, 17 contained tubercle bacilli.

Tuberculosis is one of the most serious problems that the dairyman has to face and threatens to undermine the whole industry. The bacterium that produces this disease in cattle and in man is practically the same; it is now generally agreed that the differences between bovine and human tuberculosis are slight and that either may be a source of danger to mankind. Behring is of the opinion that the larger part of pulmonary consumption is contracted in childhood from drinking milk, but that it takes years to develop and therefore generally shows later in life. Koch, on the other hand, holds that the danger of contracting tuberculosis from the milk of diseased cows is comparatively slight. Koch must be the nearer right. There is direct evidence that tubercular cows give milk containing tuberculosis bacilli; these germs do not multiply in milk but develop only within the body at body heat. The human body has good resisting powers against them when taken into the stomach in small numbers; were it not so, the disease would destroy our vaunted civilization, for tests have shown that 30 per cent. of the milk put into a large modern European city contained tubercle bacilli, and it is not likely that some of our own markets are much better. There is, however, a pronounced danger in the steady use, and for children even occasional use, of tubercular milk, no matter how much the milk of the diseased cow may have been mixed or diluted with the milk of healthy cows. No animal suffering with any disease of any kind, whether it be tuberculosis, foot and mouth disease, splenic fever, lock-jaw, hydrophobia, etc., should be allowed to furnish milk for public consumption.





**Typhoid—Scarlet Fever—Diphtheria**

After the milk is drawn from the cow there are several kinds of disease germs that may and do sometimes find their way into it and become a source of danger to the consumer. The most important of these is the typhoid fever germ. Schuder in 1901 collected records of 650 typhoid epidemics. Of this number 462 or 71 per cent. were attributed to water and 110 or 17 per cent. were traced to infected milk. Harrington, in 1907, referring to the fact that in Massachusetts they have good and well guarded water supplies adds "During the past two years, of 18 local outbreaks of typhoid fever in different parts of the state, investigated under my direction, 14 were traced to milk." Jensen said, "The principal means by which typhoid fever is distributed in places where there is a safe and hygienic water supply, is through milk," and later statistics have well substantiated this fact. A typhoid fever epidemic due to infected milk is sharp and violent and relatively short, in this respect differing from an epidemic caused by a contaminated water supply. Typhoid bacteria multiply rapidly in milk, which is well adapted to their nature and in a few hours they may become indefinitely numerous. Whenever typhoid germs are present in milk they are apt to be very abundant, and thus the percentage of people affected from drinking infected milk, is generally far greater than that of people drinking water contaminated with typhoid; and when a typhoid epidemic from milk infection does occur, the attack is explosive, severe and sudden.

Bruck in 1903 took ordinary market milk and infected it with the typhoid bacillus. He then ran the milk thus treated through a separator and found the

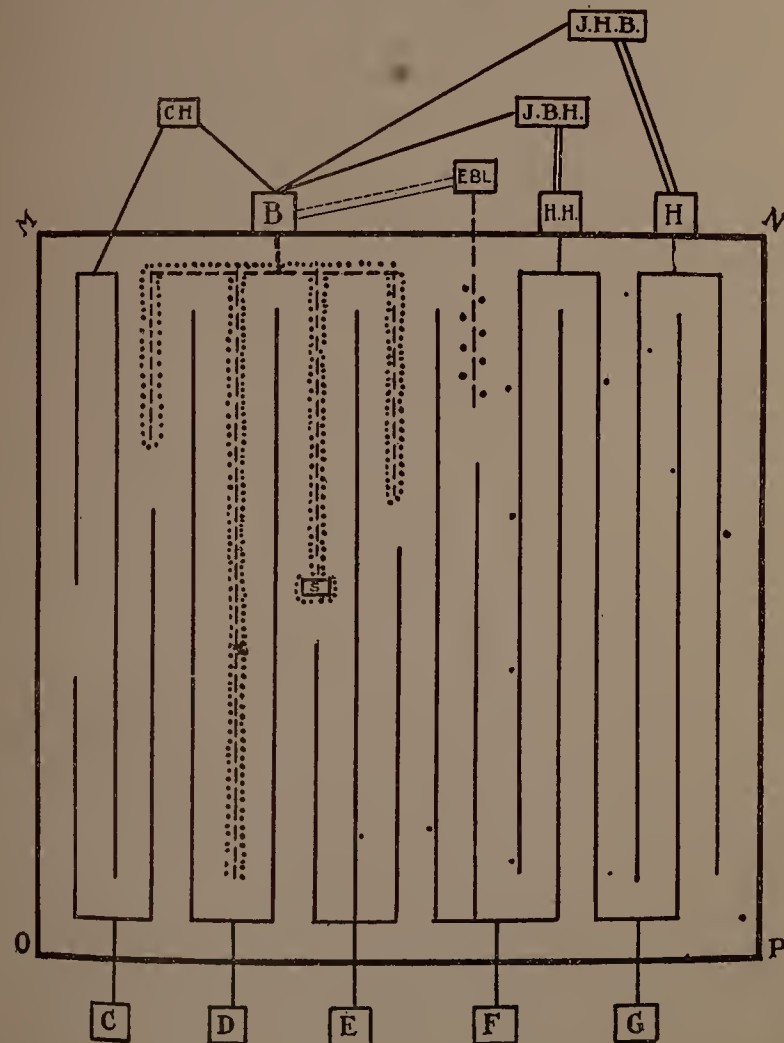


## Typhoid Epidemic—Stamford, Conn.

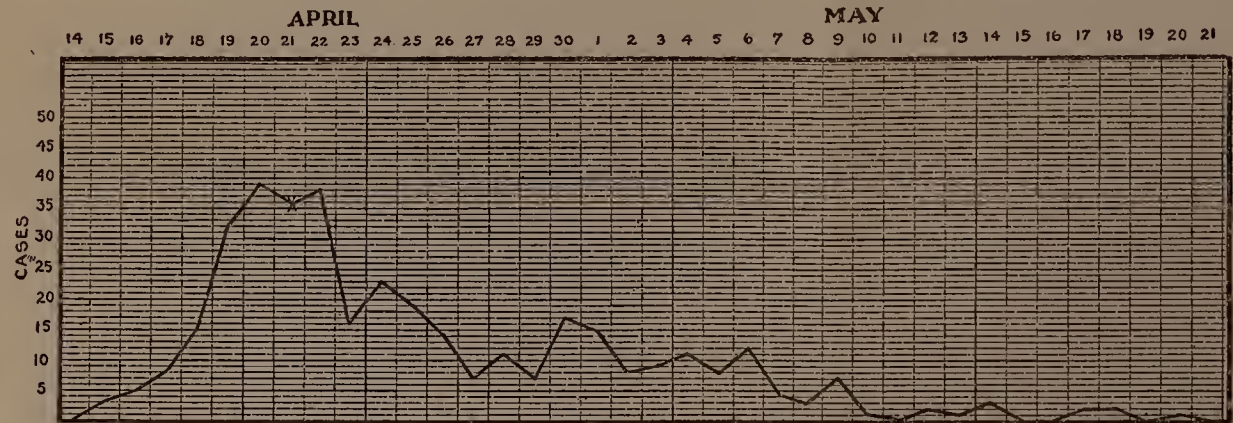
April 15 to May 28, 1895

Of 386 cases, 376 or 97.1% were traced to the use of contaminated milk from one source. The trouble originated in a shallow, unprotected, uncemented surface well  $13\frac{1}{2}$  feet deep in poorly drained soil with water grossly polluted within one foot nine inches of the surface. There was a shallow foul privy 25 feet west of the well on slightly higher ground and another 40 feet to the east. The milk cans were rinsed in this water.

Showing relation of milk routes to typhoid fever cases during the epidemic at Stamford, Conn., 1895.



Showing Number of Cases of Typhoid Fever reported each day during the Stamford outbreak



Shows Date on which the implicated dairy was closed. Note that after fifteen days the Epidemic was practically at an end.

## EXPLANATION OF DIAGRAM

The large square MNOP on the left represents the town of Stamford.

B is the dairy distributing the implicated milk, and the dash lines running from B into the city represent the milk route of this dairy. Each of the dots represents one case of typhoid fever and is placed upon the route of the dairy from which it was supplied with milk. There are 368 such cases on B's route, including the twelve around the S, which is meant to represent the cafe supplied by B. B supplied about one-eleventh of the milk used in the town.

HH and H are distributing dairies similar to B.

CH and EBL are producing farms selling milk to B and also peddling some themselves. The dash line extending from EBL represents his personal route of 5 houses in which 8 cases of typhoid occurred.

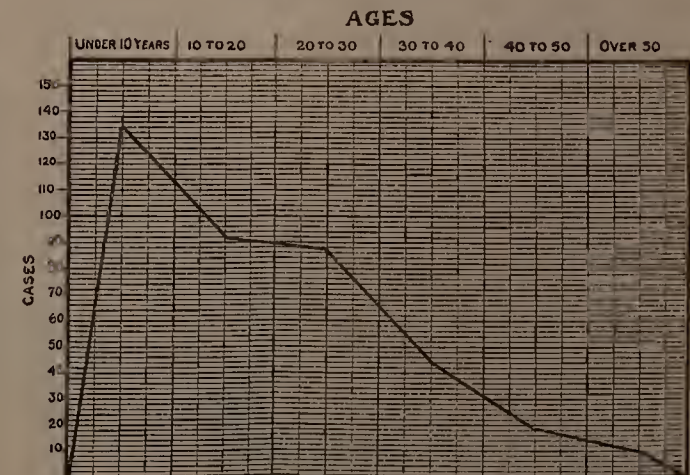
JHB and JBH are producing farms selling milk to B and also to distributing dairies H and HH.

The double lines show the dairy to which the producer sold most of his milk.

Dash lines show the apparent course of the infective agent.

C, D, E, F, and G are other dairies having routes in Stamford.

Showing in ten-year periods the ages of cases during the Stamford outbreak



Note the unusual number of cases under 10 years of age as compared with those between 20 and 30 years, the period usually most susceptible to typhoid.

The 385 cases of 1917 were placed in the same  
 unimpaired, unimpaired surface with 1917 cases  
 surface. There was a slight but not a  
 very much more than in 1917.



	Typhoid Fever	Scarlet Fever	Diphtheria
Caused by use of polluted water for diluting milk	13		
Cows drinking or wading in sewage-polluted water	6		
Dairy employees also tending sick—handling milk and act- ing as nurses	21	8	
Milk handlers ill with disease while at work	6	2	3
Disease among milch cows		20	11

Attached are most interesting graphic charts (Figs. 14-15) which tell the story of certain typical epidemics which are positively proven to have been caused by infected milk. We are indebted to State and Federal Officials for the compiling and plotting of these most excellent diagrams. It is interesting to note the percentage of total actual cases which were traceable to one source of polluted milk in the various commodities affected:

Place	Epidemic	Total number of cases	Cases traceable to a certain milk supply	Percentage of total cases traceable to certain milk supply
Stamford, Conn.	Typhoid	386	376	97.1
Norwalk, Conn.	Scarlet Fever	29	29	93.1
Dorchester, Milton, Hyde Park, }	Mass. Diphtheria	72	69	95.8
Elkton, Md.	Typhoid	39	39	100.

The Stamford charts show the progress of the typhoid epidemic and how it stopped with the closing of the implicated dairy, also how the young were affected far more than the old. This is one of the particularly great evils of any milk pollution, for the young milk drinkers—infants and children—suffer the most, whereas with water-typhoid, the adults in their prime seem to succumb far more readily, due most probably to habits of life.

The number of bacteria in milk has no relation whatever with the possibility or probability of infection from the tubercle, typhoid or diphtheria bacilli, or from that unknown something which causes scarlet fever. Milk containing 200,000,000 bacteria per c.c. is no more likely to contain any of the before mentioned disease germs than milk containing only 10,000, except, however, that the higher bacterial counts are suggestive of filthy and careless production; and as we have before said, large counts are a danger signal and should be so considered by health officers and consumers. It is to be regretted that dairy inspection is not sufficiently adequate at present to protect the public against tuberculosis, typhoid, scarlet fever and diphtheria, but a rigid honest dairy inspection would force dairymen to be more careful and cleanly in the handling of milk, and on general principles the most sanitary and hygienic dairy would be the least likely to furnish milk infected with disease germs. It is likewise unfortunate that there seem to be no practical means of examining milk in the ordinary laboratory to determine whether it contains the germs of any of these four diseases.

### **Intestinal Disorders**

Diarrhoeal diseases, summer complaint, cholera infantum are all types of intestinal disorders, common in warm weather. None can be directly attributed to a particular type of bacteria but experience indicates that they are associated with large numbers of bacteria in milk and are especially common among children in warm weather, the mortality from such diseases rising and falling with the bacterial content of the milk used, which in turn tends

to vary with the temperature. These intestinal diseases are probably of a toxic nature, the bacteria responsible acting in an indirect way, i. e., growing in the food and producing poison therein, which, when absorbed by the human digestive tract, causes direct toxic poisoning. Toxic poisoning from milk, cream, dairy products and ice cream is well known, and the latter is very prevalent. All such poisoning, however, can be avoided by the use of good fresh milk with low bacterial count. If the milk is old and has been kept cool, the bacterial count may be low, due to the checked development of the lactic acid bacteria, but in the meanwhile other injurious bacteria may have developed and become present in such large numbers as to produce toxic products. It must be borne in mind that the number of bacteria in milk depends upon (1) the conditions under which it was produced, (2) the temperature at which it has been kept, (3) the age of the milk. It makes no difference how fine a quality of milk may be produced, it will not keep in good condition unless properly cared for, and no milk will keep for any great length of time. Because milk is sweet it must not be assumed that it is healthful; old, sweet milks cause most of our milk troubles. If such milks had soured, the lactic acid bacteria would have prevented the growth of the noxious putrefactive types, and sour milk is wholesome.

### **Bacterial Content of Milk**

Until a few years ago the milk delivered in cities contained a vast and almost incredible number of bacteria. For instance, the general milk supply of Washington, D. C., during the summer of 1906

averaged 22,134,000 per cubic centimetre, with a maximum of 307,800,000, the average temperature of the milk tested being 61.7° F. In the summer of 1907 the milk tested averaged 11,270,000 bacteria per c.c. with a maximum of 280,000,000, the average temperature of the milk having been reduced to 57.6° F. and more care exercised as a result of the campaign and publicity of the previous year.

Sedwick and Batchelder in 1892 were the first to record and comment upon the bacterial content of milk used in an American city and they gave the data for the fresh milk supplied to various parts of Boston and its suburbs.

Section	No. of Samples	Bacteria Per C.C.
Charleston	8	4,222,500
Jamaica Plains	10	3,259,600
South Boston	9	2,778,000
Roxbury	17	1,874,300

Sixteen samples taken from grocery stores averaged 4,577,000 bacteria per c.c.

Knochenstern in 1893 gave the following results of examinations of milk, conducted at Dorpat, Russia, from the middle of September, 1892, to the end of January, 1893:

From milkmen	10,200,000 bacteria per c.c.
Village milk	12,000,000      "      "      "
Market milk	25,000,000      "      "      "
Shop milk	30,000,000      "      "      "

Cnof in 1889 found in the milk of München, Germany, only 5 to 6 hours after milking, from 200,000 to 6,000,000 bacteria. Renk in 1891 reported from 6,000,000 to 30,700,000 bacteria per c.c. in the milk supply of Halle. He also found an average of 15 milligrams of cow's excrement per litre

in the milk supply of Halle; Leipzig 3.8; Berlin 10.3 and München 9. Uhl in May, 1892, found in 30 examinations of the milk of Giessen, bacteria ranging from 83,000 to 169,600,000, the average being 22,900,000. Investigators of Danish milk, sold in Berlin, reported in 1907 that such milk in the summer contained "between 5,000,000 bacteria per c.c. and innumerable quantities." Dodd in 1904 gave the bacterial content of good class London milk as 4,800,000. Frye in 1896 examined 9 samples of milk in Buffalo, N. Y., as it was delivered to the consumer, and found the bacterial content to range from 48,000 to 43,600,000 per c.c. Park in 1901 found that the milk in New York, as it was received from the railroads during the summer, averaged over 5,000,000 bacteria per c.c., the maximum being 35,200,000. Byrnes in 1904 said that the milk supply of Philadelphia contained 1,600 to 21,000,000 bacteria per c.c., and Jordon in the same year stated that the milk supply of Chicago contained an average of 9,361,000 bacteria per c.c. in April, 10,071,000 in May, and 18,924,000 in June; sixteen per cent. of the samples tested showing over 20,000,000 bacteria per c.c. Bergey found an average bacterial content of 4,802,000 in ten samples of milk taken from railroad depots in Philadelphia during July, 1910. Such enormous numbers mean but little to the average mind. There are few substances that contain such myraids of germ life as is found in old and dirty milk. Sewage is a substance which is popularly and rightly supposed to teem with bacteria, but milk is, at times, far richer in bacterial life than the sewage of our large cities. Compare the average number of bacteria per c.c. of Boston,

Mass., sewage for 7 years, which was 2,800,000, with the average bacterial content of Washington, D. C., general milk supply during the summer of 1906, which was 22,134,000, or 8 times as great and with the milk found on a Washington milk wagon August 20, 1906, which contained 307,800,000 bacteria per c.c. or 110 times as many as average Boston sewage.

Sedgwick and Batchelder in 1892 found that when proper and reasonable precautions were taken, the bacterial content of fresh milk need not exceed 500 to 1000 per c.c., but when the ordinary flaring milk pail was used with more or less disturbance of the bedding, etc., the bacterial content of the milk drawn was increased to 30,000. MacConkey in 1906 felt that freshly drawn milk, obtained with care and cleanliness, should contain less than 1500 bacteria per c.c. Burr in 1902, after taking every reasonable hygienic and sanitary precaution, found 500 organisms per c.c. in freshly drawn milk, and Von Freudenreich in his attempt to obtain a bacteria-free milk found 250 to 300 organisms per c.c. Bergey obtained the following figures when operating in a dairy of the old type that made no pretensions to conform with the now well established laws of sanitation and hygiene:

Number of bacteria in milk from udder	400
Number of bacteria in milk from bucket	800
Number of bacteria after passing strainer	60,000
Number of bacteria in milk from cooler	34,000
Number of bacteria in tank below cooler	173,000
Number of bacteria after passing bottler	84,000

These figures indicate growing contamination with irregularities probably due to the difficulty of getting average samples.

If freshly drawn milk be promptly and rapidly cooled to a temperature of 50° F. or below, it is found that but little, if any, multiplication of micro-organisms occurs for some twelve hours. This fact should help very materially in the delivery of milk and the testing for bacterial content of milk as delivered to the consumer. Rosenau says that Parks' old suggested standard of not more than 12,000 bacteria per c.c. in warm and 5,000 in cold weather for freshly drawn milk seems a generous standard and one which, with a little care, should be easily attained. In regard to supply-milk 24 to 36 hours old, such as milk consumed in large cities, Parks stated that any intelligent farmer can use sufficient cleanliness and apply sufficient cold, with almost no increase in expense, to provide milk at the age stated, with not more than 50,000 to 100,000 bacterial content per c.c. and "no milk containing more bacteria than this should be used." For infant feeding the standard adopted by Dr. Coit of Newark, N. J., which limits the bacterial content of high grade milk to not more than 10,000 per c.c., was a pronounced meritorious step in the right direction. Director Rosenau of the U. S. Government Hygienic Laboratory says "As a general rule it may be stated that 'certified milk' should never exceed 10,000 bacteria per c.c., 'inspected milk' not over 100,000, and health officers should aim to keep the general milk supply below the 100,000 mark."

### **Bacterial Milk Standards**

During the last few years a large number of American cities have been paying attention to the sanitary control of market milk. Many of these

cities require that milk offered for sale shall not contain more than a given number of bacteria per cubic centimetre as shown by the ordinary methods for counting bacteria.

The following is a tabulated statement giving the bacteriological standards adopted by various cities that have a population in excess of 100,000. Whether or not these standards are being rigidly enforced, persistently or intermittently, or altogether ignored is, as Kipling would say—"another story."

Cities	Estimated Population July 1st 1914	Maximum Number Bacteria Allowed Per. C.C.	Standard Applies to	Standard Applies During
Albany, N. Y.	102,961	500,000	Cream only	Entire year
Atlanta, Ga.	179,292	100,000	Raw Milk	" "
		50,000	Pasteurized Milk	" "
Baltimore, Md.	579,590	500,000	Raw Milk	" "
		15,000	Certified Milk	" "
Birmingham, Ala.	166,154	500,000	Raw Milk	" "
Boston, Mass.	733,802	500,000	Raw Milk	" "
Cambridge, Mass.	110,357	500,000	Raw Milk	" "
		100,000	Inspected Milk	Oct. 1—May 1
Chicago, Ill.	2,393,325	150,000	" "	May 2—Sept. 30
		150,000	Inspected Cream	Oct. 1—May 1
		300,000	" "	May 2—Sept. 30
Columbus, Ohio	204,567	500,000	Raw Milk	Entire year
Dayton, Ohio	123,794	100,000	Raw Milk	" "
Fall River, Mass.	125,443	200,000	Raw Milk	" "
Grand Rapids, Mich.	123,227	200,000	Raw Milk	" "
Indianapolis, Ind.	259,413	500,000	Raw Milk	" "
Kansas City, Mo.	281,911	300,000	Raw Milk	" "
Los Angeles, Cal.	438,914	500,000	Raw Milk	" "
Lowell, Mass.	111,004	500,000	Raw Milk	" "
Milwaukee, Wis.	408,683	250,000	Raw Milk	" "
Minneapolis, Minn.	333,472	500,000	Raw Milk	" "
Nashville, Tenn.	114,899	200,000	Raw Milk	" "
		10,000	Certified Milk	" "
Newark, N. J.	389,106	30,000	Guaranteed Milk	" "
		50,000	Pasteurized Milk	" "
		100,000	Inspected Milk	" "
New Bedford, Mass.	111,230	500,000	Raw Milk	" "

		100,000 Raw Milk	Winter Season
New Haven, Conn.	144,505	500,000 Raw Milk	Summer Season
New York, N. Y.	5,333,539	50,000 Pasteurized, Grade A	Entire year
		60,000 Raw Milk, Grade A	" "
		100,000 Pasteurized, Grade B	" "
Oakland, Cal.	183,002	75,000 Raw Milk	Oct. 1—Mar. 31
		100,000 Raw Milk	Apr. 1—Sept 30
Pittsburgh, Pa.	564,878	500,000 Raw Milk	Entire year
Portland, Ore.	260,601	100,000 Pasteurized Milk	" "
		200,000 Raw Milk	" "
Salt Lake City, Utah	109,530	15,000 Class A Milk	" "
		50,000 Pasteurized Milk	" "
		80,000 Class B Milk	" "
		250,000 Class C Milk	" "
San Francisco, Cal.	448,502	10,000 Certified Milk	" "
		100,000 Inspected Milk	" "
Seattle, Wash.	313,029	400,000 Raw Milk	" "
St. Louis, Mo.	734,667	50,000 Pasteurized Milk	" "
St. Paul, Minn.	236,766	500,000 Raw Milk	" "
Syracuse, N. Y.	149,353	50,000 Inspected Milk	" "
		10,000 Certified Milk	" "
		250,000 Market Milk	" "
Tacoma, Wash.	103,418	200,000 Raw Milk	" "
Toledo, Ohio	184,126	500,000 Raw Milk	" "
Trenton, N. J.	106,831	100,000 Raw Milk	" "
Worcester, Mass.	157,732	500,000 Raw Milk	" "

A numerical bacterial standard is a somewhat indefinite gauge of filth, temperature and age combined. It cannot insure the wholesomeness of the milk as it does not tell us the types or nature of the bacteria present. It is also difficult to enforce; it takes practically 24 hours to test the milk sample and when the results are determined the milk has been distributed and probably consumed. In spite of all this, the numerical standard has certainly proved to be of value, indirect rather than direct. It has made the dairymen more careful and improved dairy conditions and compliance with its demands has resulted in a pronounced improvement in the grade and wholesomeness of milk. "Care means safety and the extent of the care is the extent of the safety." As the number of bacteria in milk has become smaller, the death rate of children

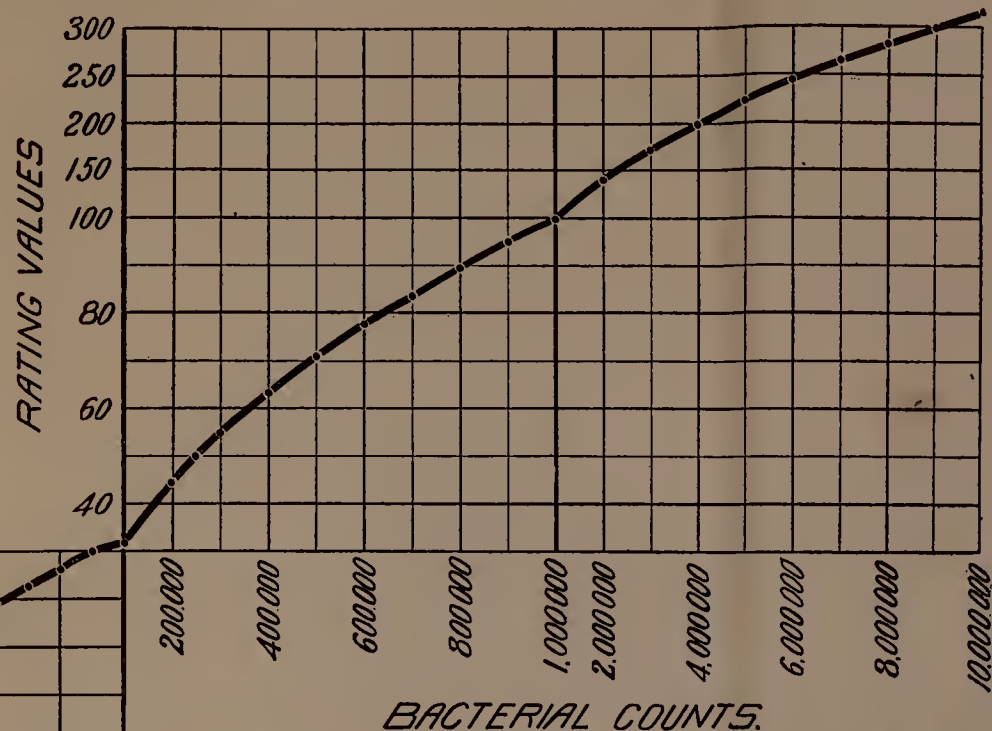
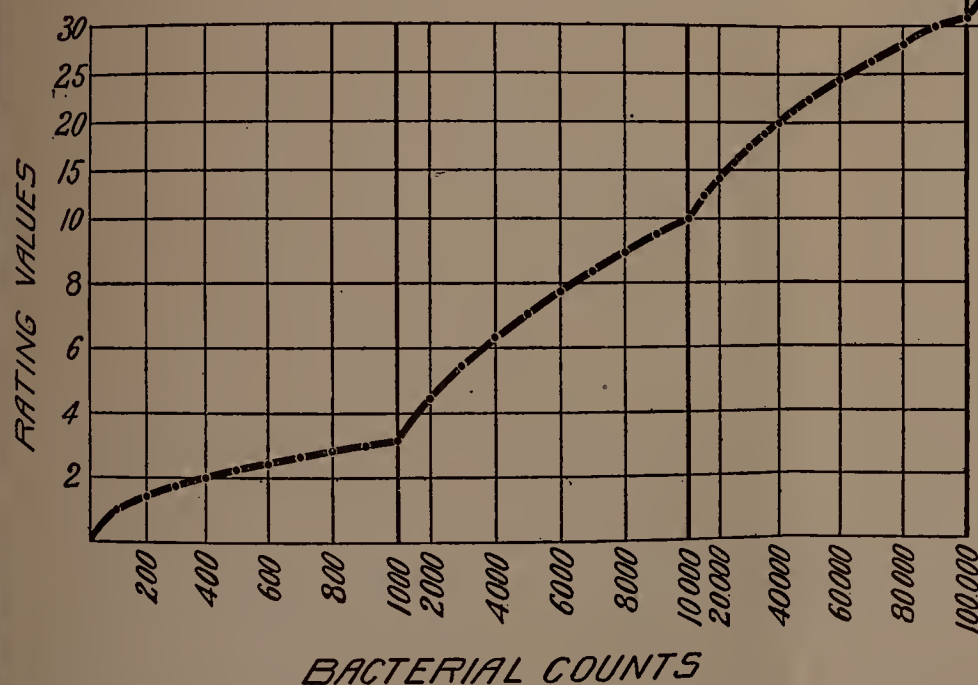


# PARABOLIC CURVES FOR BACTERIAL COUNTS

FOR any bacterial count a corresponding value can be found by observing the point on the curve intersected by a line leading upward from the bacterial count and following the line of rating value which leads to the right or left at this point. Thus the line leading upward from 10,000 bacteria strikes the curve at a point through which passes the line leading to the left having rating value of 10, and bacterial line 40,000 meets curve at point intersected by line of rating value 20; bacterial line 1,000,000 meets rating line 100.

In the diagram a series of parabolic curves are shown, the horizontal scale or abscissae value being very much condensed on the larger counts in order to save space. The ordinate value or scale of normal rating is also somewhat condensed as the rating increases, but to a far less extent for the same reason.

The scale of bacterial count changes at 1,000, 10,000, 100,000 and 1,000,000. These shortenings account for the disjointed appearance of the curves.



THIS table is used as follows: Assume that a health board laboratory makes four consecutive examinations of the milk of a single dealer, and finds bacterial counts as follows: 25,000, 70,000, 250,000 and 5,000,000. It desires to determine in what class this milk belongs. To express the character of the milk in a single figure, set opposite each bacteria count the normal rating value found in the above table. This would be as follows:

BACTERIA COUNT	NORMAL RATINGS
25,000	15.8
70,000	26.4
250,000	50.0
5,000,000	224.0
	<hr/>
	4)316.2
	79.0

After the normal ratings are obtained for each figure, they are added together and averaged, as shown above, giving the average rating 79. Again referring to the table, it will be observed that this is equivalent to a bacteria count of about 630,000. Consequently the final character of the milk will be expressed by the figure 630,000 bacteria per cubic centimetre. Pursuing this system with all milks makes it possible to express their character in a single figure in terms of bacteria which it is suggested should be called "the bacterial content."

FIG. 16.

has decreased and it is now generally admitted that a numerical standard with all its limitations is of great value in raising the quality of milk in any community; it lessens the extent of toxic poisoning and, moreover, reduces the danger of its being the cause of diseases and infectious epidemics.

New York claims that it is impossible to enforce a standard to cover its entire milk supply on account of its complexity, enormous volume and distance that has to be travelled to obtain its supply, said to be over 400 miles. A standard fixed, unusually high, viz.: 1,000,000 was undertaken by the New York Board of Health and later abandoned, their principal difficulty, it was said, being to properly place the responsibility for poor milk. Boston made a strict standard in 1905, also very high—500,000, but they have had the courage, and probably a more effective organization, to maintain it. There is no excuse to-day for any city, no matter how large, tolerating the sale of bad milk. If the public health needs to be safeguarded by a pure water or pure milk supply it can be done, if sufficient thought and constructive energy is put into it and politics impregnated with selfishness, arrogance and inefficiency are relegated to the rear.

#### **Classification of Dealers' Milks**

The New York Commission on Milk Standards recommended in 1912 the use of North's modification of Levy's method of giving each bacterial count a rating value. This modification consists in the use of such values as can be obtained from a parabolic curve having as ordinates the ratings and as abscissae the bacterial counts. The final state-

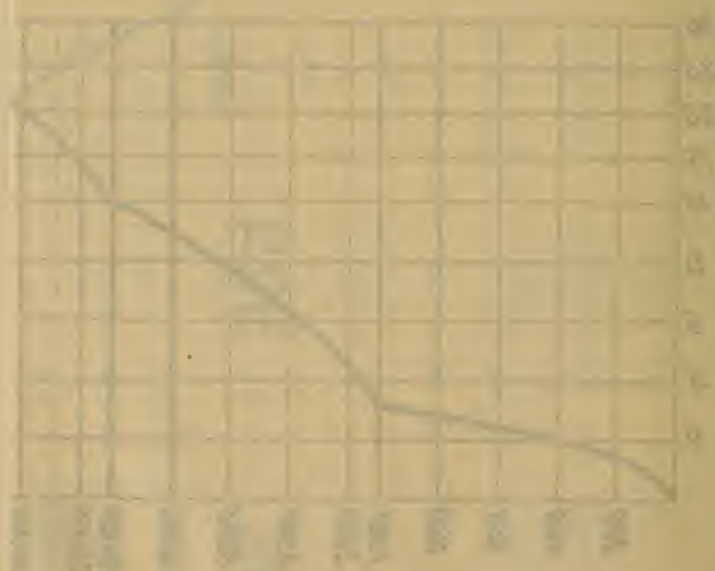
# RATING VALUES



# PARABOLIC CURVE

The following table gives the values of the function  $y = x^2$  for  $x$  ranging from 0 to 10. The values are rounded off to two decimal places. The curve is a parabola opening upwards with its vertex at the origin (0,0).

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Graph of the function  $y = x^2$

ment of a series of bacterial counts is given as a single figure, which expresses the sanitary character of the milk in terms of bacteria per c.c. It was recommended that this figure be known as the "Bacterial content." The method proposed aims to recognize all high counts, but at the same time, because of the ability of some bacteria to multiply with extreme rapidity, it is necessary in making a bacterial rating to obtain figures much more representative of the real average character of milk (as given by several samples obtained within not more than a month's time) than could be obtained by single arithmetical averages. Attached will be found a set of curves made from Dr. C. F. North's computed values, also stated in table form.

In comparing the result of one year's work with another, or of one city's milk supply with that of another, the New York Commission recommends the use of the Levy Method of stating the results of bacterial counts. The bacterial counts are divided into groups and to each group percentage values are given, the final expression being made as a single figure in terms of percentage. The groups and percentage values recommended for each are:

Rating		Rating	
Bacterial Content	Per Cent.	Bacterial Content	Per Cent.
Under 10,000	100	250,000 to 500,000	20
10,000 to 50,000	90	500,000 to 1,000,000	10
50,000 to 100,000	75	Over 1,000,000	0
100,000 to 250,000	50		

In using the above table, the bacterial content should be obtained from the North parabolic curves for several samples of milk and the average, or

rating figure obtained. Such bacterial content figures are then divided into groups, each number being multiplied by the percentage value of its group, as illustrated in the following table:

Bacterial Content	No. of Test Series	Corresponding Rating Figures	Product
Under 10,000	15	100	1,500
10,000 to 50,000	20	90	1,800
50,000 to 100,000	30	75	2,250
100,000 to 250,000	40	50	2,000
250,000 to 500,000	35	20	700
500,000 to 1,000,000	50	10	500
Over 1,000,000	10	0	0
<hr/> Total		200	<hr/> 8,750

$$8,750 \div 200 = 43.75 \text{ per cent. average rating.}$$

This average of all percentages has been named by Levy the "Bacterial Index."

### Nature and Action of Milk Bacteria

Almost any of the known forms of bacteria may live and grow and occasionally be found in milk. Normally, however, a comparatively few general forms of bacteria are present; these cause various changes in the constituents of milk and are known as organized ferments. We have already discussed the bacteria of germ diseases, the pathogenic micro-organisms which may be found in milk having been carried therein from a diseased animal, through the atmosphere, from utensils, water, or from attendants, milkers or handlers of milk suffering from or carrying disease, and this phase we need not dwell upon further. The presence of bacteria to some extent in milk is inevitable, but it is essential that

only the common normal types of bacteria apparently natural to it be ever permitted to enter milk. Normal bacteria have been defined as those "that under all ordinary circumstances are practically certain to be found in milk; their presence must always be expected and it is practically impossible to avoid them." Abnormal bacteria are those which are less common or unusual "occurring in milk under certain conditions, but which can generally, by proper means, be prevented from getting into the milk in quantities large enough to produce any effect." Bacteria in milk must be studied from three standpoints:

- First:* Their effect upon the human organism;
- Second:* Their action on milk and its relation to all who deal with this product, and
- Third:* Their relation to butter and cheese-making.

While bacteria may be regarded as undesirable, as far as milk is concerned, yet the manufacturer of dairy products, such as butter and cheese, are dependent upon their action, and sour milk or lactic acid buttermilk is a most healthful beneficial drink. It has been said that certain bacteria that are troublesome to the dairymen are wholesome to the consumer, while on the other hand, some bacteria that are very injurious and even fatal to the consumer are of no special significance in dairying, so far as their effect upon milk is concerned. The latter fact is to be regretted, for if every form of micro-organism deleterious to man would but ruin the product of the dairyman whenever it was permitted to get into his milk, it would not be long before pure safe milk would be universally distributed and be as common as it is now uncommon. The normal fermenta-

tion to which milk is subject may be divided into three classes:

- First:* Lactic fermentation caused by lactic acid bacteria of several types, two, however, of which predominate and which feed upon and cause changes in the milk sugar.
- Second:* The changes caused by bacteria feeding upon the albuminoids of the milk, which can be further classified as peptogenic and putrefactive. To this general class belong the rennet-forming bacteria, which produce an abnormal condition known as sweet curdling.
- Third:* Butyric fermentation which attacks the fats. Abnormal milk bacteria produces unusual fermentation in milk, which results in slimy milk, bitter milk, red and other colored milk (chromogenic fermentation), turnip milk and soapy milk, etc.: certain yeasts cause alcoholic fermentation and *oidium lactis*, a semi-mold, may affect old milks.

The lactic acid bacteria are of many types, but two, the *Bacterium Lactis Acidi*, also known under a multiplicity of other technical names, and the *Bacterium Aerogenes* stand forth pre-eminent. The former is the dairyman's friend; it turns the milk into a sour, smooth, solid curd with no odor, free of gas bubbles and without the separation of any whey. Such curdling is favorable for the production of the best grades of butter and cheese. This organism grows readily at temperatures from 60° to 100° F. At a temperature of about 70° F. it grows with great rapidity and at this temperature seems to be more vigorous than any other bacterium ordinarily found in milk. For this reason, milk kept at about 70° F. becomes in a short time almost completely filled with this type of bacteria at the ex-

pense of all the others originally present. The *Bacterium Aerogenes* of the lactic acid group is not as common as the *Lactis Acidi*, but is nevertheless widely distributed and is likely to be present in any sample of milk. The curd produced by this bacterium is always more or less filled with gas bubbles and when bacteria of this class are present in considerable quantity which, fortunately for the cheesemakers, is not very often, they do much mischief and make what is known as swelled, bad-flavored cheese, a commodity which is practically worthless. Their presence in quantity is not so disastrous in butter making, but they are the cause of unpleasant flavors and a lowering of grades. When milk has been kept around 70° F. or somewhat lower, it will in most cases be soured by the *Lactis Acidi* Bacteria; if kept above 80° F. it is apt to be soured by the less desirable *Aerogenes* Bacteria.

The *B. Coli Communis* is often found in milk and as the presence of this organism in water is a sign of sewage contamination, its presence in milk indicates filth and prevailing unsanitary dairy conditions. This type of bacillus lives in the intestines of animals and when it appears in milk it is sure proof that the milk is polluted with animal excreta. It is said that the *B. Coli* is found with great frequency in milk and if such milk should be placed under ban, a large proportion of the milk distributed as pure, wholesome milk would be driven from the market. Such bacteria are not pathogenic nor seriously harmful of themselves. Animal faeces are far less dangerous to man than human excreta and the *B. Coli* in drinking water, being a sure sign of water contamination, is far more serious than the presence of *B. Coli* in Milk; nevertheless, this is no

reason why Milk Experts should ignore the existence of bacteria in milk, the presence of which is indicative of filth. Animal faeces in milk is not an appetizing matter and, although it may not distribute infectious disease, it is indictative of foulness which, unless corrected, may quite easily express itself in a more serious manner. Filth and disease are synonymous terms as regards the production and handling of milk. Bacteria get into milk from the udder, air, milking vessels and utensils, water (used for cleaning and at times for diluting), and from the milkers and milk handlers. The lactic acid bacteria are to be found in air, soil and water and the dangerous disease germs enter milk usually from the human attendants, milkers and handlers. Milk when drawn from a cow is at a temperature that favors the development of most ordinary species of bacteria and it would seem that the majority of them multiply most rapidly at about body heat, or  $90^{\circ}$  to  $100^{\circ}$  F. Conn gives the following interesting synopsis of bacterial action affected by temperature:

$33^{\circ}$  F. If milk is frozen, bacteria do not grow at all. If a degree or two above freezing they grow very slowly, so slowly that for days there is practically no increase in numbers. After two or three weeks, they are found to be abundant. Such milk will neither sour nor curdle, and although "sweet," it may, when very old, contain bacteria in great numbers and be quite harmful.

$40^{\circ}$  F. Same conditions, but bacteria grow more quickly. Many cases of milk and ice-cream poisoning can be attributed to keeping milk and cream for many days at low temperatures. "The emphatic lesson to be drawn is that no normal milk that has

been kept for many days is safe even though it remain sweet."

50° F. Same condition, but bacteria develop still more rapidly. At this temperature the species which grow are commonly not lactic bacteria but a large variety of miscellaneous forms which, though generally harmless unless present in tremendous quantities, are more likely to contain species which give ptomaine poisoning, summer complaint, cholera infantum.

60° F.—70° F. The growth of bacteria is very rapid at this temperature, which is favorable to the normal, harmless and useful lactic acid bacteria, and they multiply far more rapidly than any other species. "At the outset, the number of lactic acid bacteria is comparatively small, frequently less than one per cent., and seldom as high as 10 per cent., but they constantly increase hour after hour and when the milk is 24 hours old, the lactic acid bacteria are apt to comprise 50 per cent. of the whole. In another day, just about the time the milk is ready to sour, the proportion of this type is commonly over 95 per cent. In other words, if milk is preserved at a temperature of from 60° to 70° the lactic acid bacteria far outrun other species and soon take their place. The acid which they develop seems to be injurious to the other species and these rapidly disappear as the lactic organisms increase in numbers. Milk which sours at a temperature of about 70° F. will, as a rule, be found to contain nearly a pure having disappeared." Lactic acid bacteria are not present in quantity in fresh milk; they represent a organisms which were so abundant at the outset culture of the common lactic acid type, the other woefully small minority of bacterial life. When the

milk is kept at ordinary temperature, however, they soon outnumber the other species and are the dairy bacteria par excellence.

80° F.—100° F. At these temperatures, the *Bact. Lactis Acidi* and the gas-producing *Bac. Aerogenes* may fight between themselves for supremacy and possibly both may succumb to some other species which may dominate the mass. At all such temperatures the results are variable and milk to be used for butter or cheese-making has to be kept below 80° F.

Lactic bacteria protect the milk from putrefaction and it has even been seriously suggested that milk to be used for drinking "should be inoculated with lactic bacteria to insure their presence and aid in the exclusion of other species." Pasteurized milk which has been robbed of its lactic acid protecting bacteria will ordinarily not sour and it seems to keep good for a long time, but such milk inevitably and ultimately undergoes decomposition and the milk becomes vile with age and unfit for use. Lactic acid bacteria are not harmful but seem to have a beneficial effect upon the human intestinal tract. Buttermilk and lactic acid sour milk may contain 500,000,000 bacteria per c.c. and are recommended very extensively to invalids, both adults and children. The bacterial count, therefore, must be used with judgment and deliberately soured milk must not be confused with milk that is claimed to be pure, fresh and sweet.

### **Pasteurization of Milk**

Pasteurization as applied to milk consists of heating it for a certain period of time at a temperature below the boiling point, followed by rapid chilling. The object is not so much to preserve the milk as it

is to destroy the harmful bacteria and their product. Pasteur in 1860-1880 devised methods of treating wines and beers to prevent souring and undesirable fermentation. He heated wine for a few minutes to a temperature of about 120°-140° F. and beer to 110°-130° F. and the application of this process gave rise to the new term "pasteurization." In 1886, Soxhlet advocated the heating of milk for infant feeding. He termed it "sterilization" but it was soon proven that he was deceiving himself and his "sterile" milk was far from being sterile and under certain conditions, when aged, produced harmful results. Pasteurized milk really means heated milk and is not necessarily synonymous with *clean* milk, *good* milk or *pure* milk and it describes in no way the source or the original quality of the milk. Pasteurization does not claim to be sterilization but it is an attempt to destroy harmful bacteria without injuring the milk. It has been found that heating milk for prolonged periods and at very high temperatures is undesirable and, moreover, unnecessary. The scientific heating of milk at a certain temperature and for a certain period of time, sufficient and no more, to kill harmful bacteria is pasteurization, provided the milk immediately after being subjected to heat is rapidly cooled; this latter phase is an important part of the process. Rosenau says, "In order to correct the misconception concerning 'pasteurized milk' it would be better to discontinue the use of the term and use in its place 'heated milk' stating the degree of heat and the time of exposure on each bottle as well as the date on which the milk was heated." We could also add the date the milk was taken from the cow and the

data pertaining to subsequent cooling after the heating process.

If heated milk is cooled slowly or naturally it will remain for a long time at temperatures between 65° and 100° F. which thermal condition is favorable for the development of bacteria and their toxic products, hence the need of immediately chilling heated milk after it has gone through the first stage of the pasteurization process.

Pasteurization, it has been said, "merely temporarily checks fermentation." Bitter said that it "destroys a large part of the bacteria in milk and this reduction in numbers greatly increases its keeping property." Conn has stated that the chief effects of scientific pasteurizing are (1) the destruction of the larger part of the lactic acid bacteria and as a consequence pasteurized milk will not ordinarily sour. (2) The destruction of the germs of specific diseases, including tuberculosis, typhoid fever, scarlet fever and diphtheria. We therefore see that pasteurizing, properly performed, kills all pathogenic bacteria and herein lies its great worth to mankind, but in destroying these noxious micro-organisms, it also robs the milk of its natural "germicidal" properties, for it kills the lactic acid bacteria and any surviving species of bacteria will not have so hard a struggle for existence in heated milk as in ordinary milk. Rosenau says, "Pasteurized milk must be handled at least as carefully as raw milk, if not more so," and "Bacteria grow more readily in heated than in raw milk." Pasteurized milk keeps longer than raw milk because it has been robbed of the lactic acid bacteria that sour it, but pasteurized milk ages and rots and should not be used when old. Pasteurization cannot make poor milk into good milk; it can

kill all pathogenic germs therein but it cannot atone for filth. Pasteurization does not make clean milk. Milk is the most wholesome and nourishing liquid consumed by man. It is nature's food to the young of each species of mammals, but milk taken from the female of any species and used for consumption elsewhere or indirectly, becomes as dangerous as well as a nourishing commodity. Milk is of all substances the most difficult to handle and preserve pure and wholesome. Milk is a strange contradiction, it being the most wholesome food fluid and sometimes one of the most poisonous of all foods. Pasteurization is a corrective method designed to destroy noxious bacteria in milk; preventive methods are better, for "pure milk is better than purified milk," but if dairy men will not adopt means to safeguard the health of milk consumers, pasteurization may become necessary to rid market milk of its insidious foes to health and infant life. Children and particularly young infants need pure, raw milk. Pasteurized milk is a milk that has undergone certain changes and it is not as healthful as pure, raw milk for the very young; it is, however, when well prepared and made from fresh good milk, far better than questionable, dirty and old, stale milk, as the children's mortality report of any large city, using pasteurized milk, will clearly prove.

U. S. Government Reports state that the average commercial milk of large cities is not a safe food. The principal reasons for this are the ignorance and indifference of those engaged in the dairy business, filthy barns, unclean and unhealthy cows, improper care of utensils and containers, insufficient cooling of the milk, unconcern in regard to the guarding of water to prevent contamination, long transporta-

tion, unnecessary and frequent handling, imperfect cleaning and lack of sterilization of the containers, bottles, etc., indifference to the laws of hygiene and sanitation, carelessness pertaining to the cleanliness and health of dairymen and milk handlers and frequent close association with contagious or infectious diseases.

Investigators commenting on the difficulty in obtaining a clean and reliable fresh milk supply in our large cities, tell us that Washington is supplied by 1,000 farms located in two states, some of the cream coming from distant points in Pennsylvania and New York. Boston obtains its required milk from a large area within a radius of about 100 miles. The milk consumed in New York is produced in about 40,000 farms, scattered over 8 different states, passes through more than 400 creameries, and comes over 12 different lines of transportation. Some of the milk, at certain seasons, reaches New York from the provinces of Ontario and Quebec, Canada, and shipments of cream arrive daily from Ohio. One hundred and fifty wholesale dealers are engaged in the business and the retail stores number over 13,000; the daily consumption is about 2,500,000 quarts of which only 50,000 quarts is Grade A Raw certified or uncertified, 150,000 quarts Grade A pasteurized and the remainder (about 2,300,000 quarts) is Grade B pasteurized. From this extreme case we find every grade of complexity down to the small village and the individual farmhouse where fresh milk is obtained twice daily.

Pasteurization in bulk is practiced on a large scale in Europe particularly where tubercular cattle are common. The Danish Law of 1898, requiring pasteurization, was a "measure for combating

tuberculosis in cattle and hogs." If cattle need protection from infected milk, how much more does man! Commercially pasteurized milk is in general use in Berlin, Copenhagen, Paris, etc., and in all congested centres its use is being rapidly extended.

The changes produced in milk by heating depend upon the degree of heat and the length of exposure. Scientific pasteurizing, we are told, does not appreciably affect the chemical and physical properties of milk and has no effect upon its digestibility or ease of assimilation. The heat applied in pasteurization does not materially affect the taste, if at all, nor do the albuminoids of the milk coagulate. When milk is boiled or "sterilized," however, the results are very different; pronounced changes are produced and the taste and virtue of the fluid materially impaired. It has been claimed that whereas laboratory experiments do not show it, nevertheless pasteurization does impair the all-round food value of milk and affects particularly in the case of children its ease and thoroughness of assimilation. Conn, discussing this subject, advocates home pasteurization and says, "The danger to children from tuberculosis and other troublesome diseases in the milk has not yet been guarded against by any public means. Hence, there is a growing tendency on the part of people of intelligence, who are bringing up children on milk, to pasteurize it. This plan is to be recommended in cases where the child must depend upon milk, the source of which cannot be strictly relied upon. Perhaps such pasteurized milk is not as valuable a food as unpasteurized milk from absolutely reliable sources, but with the conditions in our cities, it is almost impossible to find milk that can be strictly relied upon to contain no dangerous dis-

ease germs. Under these circumstances pasteurizing is the only safe method by which a young child can safely be fed upon milk."

The Commission on Milk Standards originally appointed by the New York Milk Committee, with recognized experts from all parts of the country and whose reports have been incorporated into the records of the U. S. Public Health Service, have said: The Commission thinks that pasteurization is necessary for all milk, at all times, excepting Grade A, raw milk. The majority of the Commissioners voted in favor of the pasteurization of all milk, including Grade A, raw milk. Since this was not unanimous, the Commission recommends that the pasteurization of Grade A, raw milk be optional. The process of pasteurization should be under official supervision. Automatic temperature regulators and recording thermometers should be required and the efficiency of the process frequently determined by laboratory testing.

The destruction of the chemical constituents of milk by heat occurs at higher temperatures than those necessary for the destruction of the bacteria of infectious diseases transmissible by milk.

The Commission passed a resolution regarding the temperature of pasteurization as follows:

That pasteurization of milk should be between the limits of 140° F. and 155° F. At 140° F. the minimum exposure should be 20 minutes. For every degree above 140° F. the time may be reduced by 1 minute. In no case should the exposure be for less than 5 minutes.

In order to allow for a margin of safety under commercial conditions, the Commission recom-

mended that the minimum temperature during the period of holding should be made 145° F. and the holding time 30 minutes. Pasteurization in bulk when properly carried out has proven satisfactory, but pasteurization in the final container is preferable and should be encouraged.

The Commission also required that milk to be pasteurized should be cooled when taken from the cow, and held at or below 60° F. until it is pasteurized. (They should have required a maximum temperature of 50° F. instead of 60° F.) After pasteurization they insisted that the milk be held at a temperature not exceeding 50° F. until delivered to the consumer.

The Commission's requirements in regard to Bacterial Standards of Pasteurized Milk are:

"It shall not contain more than 1,000,000 bacteria per c.c. before pasteurization, nor more than 50,000 when delivered to the consumer," but it is recommended that the limits both before and after pasteurization be lower.

The two dominant factors that control the temperature and time at which milk shall be pasteurized are, (1) the thermal death points of pathogenic bacteria, and (2) the ferments in the milk. The first must be surely killed so as to eliminate this danger, and the second should not be affected sufficiently to "devitalize" the milk.

So far as we are able to judge from our present knowledge, the best temperature is 145° F. continued for twenty minutes. A higher degree of heat for a shorter period is just as effective so far as the destruction of the bacteria is concerned, but high temperatures in the treatment of milk are to be avoided. Freeman in 1907 recommend 140° F.

for 40 minutes; Smith in 1899,  $140^{\circ}$  F. for 20 minutes; Hippius in 1905,  $140^{\circ}$  F. for one hour; Hesse, Russell and Hastings in 1900 all recommended a temperature of  $140^{\circ}$  F. maintained for 20 minutes. Fortunately none of the micro-organisms causing tuberculosis, typhoid fever, diphtheria, scarlet fever, Malta fever, dysentery, etc., are spore-producing bacteria, therefore, a comparatively moderate degree of heat is sufficient to destroy them. Rosenau's experiments with the tubercle bacillus upon guinea pigs, demonstrate conclusively that the bacillus loses its virulence and infective power when heated at  $140^{\circ}$  F. for 20 minutes; in other words, it may be considered dead. When heated to  $149^{\circ}$  F. a much shorter time is necessary. Summing up the research investigations conducted with reference to the thermal death point of pathogenic micro-organisms in milk, Rosenau says: "The evidence is plain that milk heated to  $140^{\circ}$  F. and maintained at that temperature for two minutes will kill the typhoid bacillus. The great majority of those organisms are killed by the time the temperature reaches  $138^{\circ}$  F., and few survive to  $140^{\circ}$  F.

The diphtheria bacillus succumbs at comparatively low temperatures. Oftentimes it fails to grow after heating to  $131^{\circ}$  F. Some occasionally survive until the milk reaches  $140^{\circ}$  F.

The cholera vibrio is similar to the diphtheria bacillus so far as its thermal death point is concerned. It is usually destroyed when the milk reaches  $131^{\circ}$  F.; only once did it survive to  $140^{\circ}$  F. under the conditions of the experiments.

The dysentery bacillus is somewhat more resistant to heat than the typhoid bacillus. It sometimes withstands heating at  $140^{\circ}$  F. for five minutes. All

are killed at  $140^{\circ}$  F. for ten minutes. However, the majority of these micro-organisms are killed by the time the milk reaches  $140^{\circ}$  F.

So far as can be judged from the meager evidence at hand,  $140^{\circ}$  F. for twenty minutes is more than sufficient to destroy the infective principle of Malta fever in milk. The *M. melitensis* is not destroyed at  $131^{\circ}$  F. for a short time; the great majority of these organisms die at  $136.4^{\circ}$  F. and at  $140^{\circ}$  F. all are killed.

Milk heated to  $140^{\circ}$  F. and maintained at that temperature for twenty minutes may, therefore, be considered safe so far as conveying infection with the micro-organisms is concerned.

It is fortunate that the thermal death point of the pathogenic bacteria which most concern us, is below those of the ferments in milk, for in this way all infectiousness may be destroyed without "devitalizing" the milk.

An interesting chart, prepared by Dr. North, is attached, which shows graphically the temperature and time of exposure necessary to effectively destroy pathogenic micro-organisms and properly treat the milk during the first or heating stage of the process of pasteurization.

It is to be regretted that conditions are such as make the pasteurization of milk in many cases essential for the proper safeguarding of health. It has been clearly demonstrated that pasteurization prevents sickness and saves lives, but unless drastic laws are passed to protect the public, it is apt to promote carelessness in the dairy, discourage the efforts to produce clean milk and take the place of inspection and improvements in dairy methods and conditions. Milk should not be pasteurized unless it con-

forms with certain chemical and bacteriological standards, and *if it is known to be unfit for sale as a*

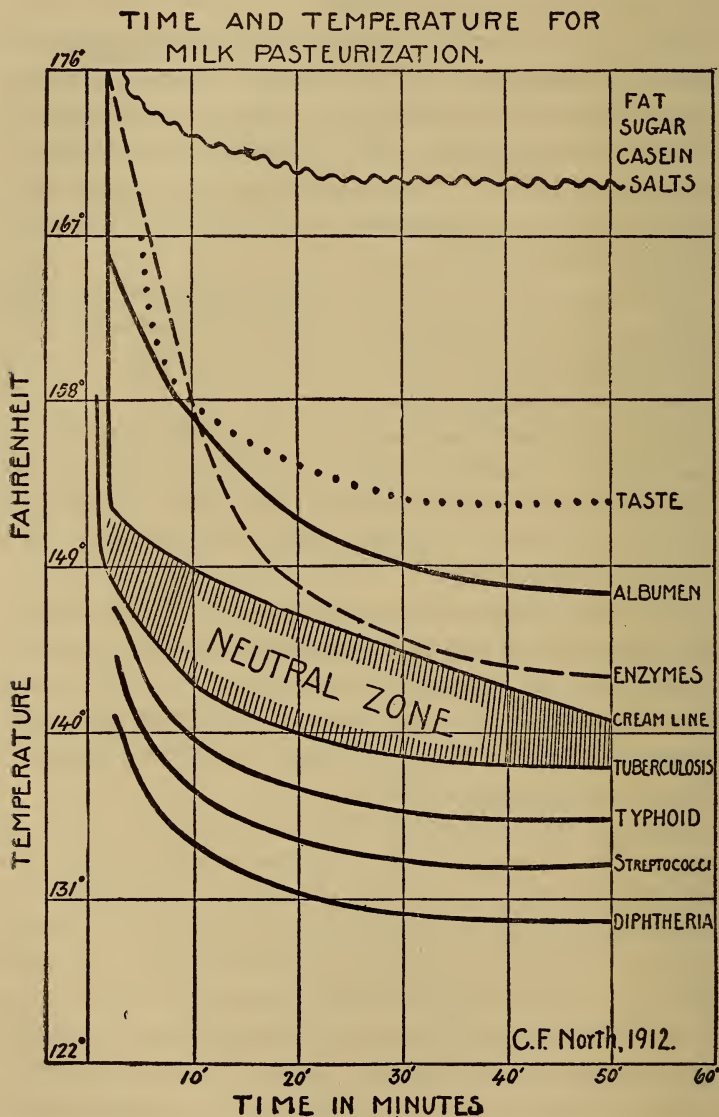


FIG. 17.

*good, clean, fresh milk it should be unfit for pasteurization.*

Nathan Straus has devoted much time and money to improving the quality of city milk and has been a strong advocate of pasteurization. In a paper prepared for the Seventh International Congress of Applied Chemistry he said, "I have done what one man could do to stop the slaughter of children. In 1892 I was convinced that infected milk was responsible for the excessive infantile death rate and for the persistence of tuberculosis among human beings. Forthwith I proceeded to put pasteurized milk within the reach of the children of New York City. Instant was the response in decreased mortality and conclusive was the demonstration obtained by feeding the city waifs on Randall's Island with pasteurized milk, resulting in the reduction of the death rate from 44 to 19.8 per cent.

\* \* \* My work was bitterly opposed. I could only point to the babies fed upon pasteurized milk to prove that I was right. Objections to pasteurization multiplied, based entirely upon ignorance or hostility at the idea of a mere layman teaching how to save lives. \* \* \* With no purpose but to save lives I was compelled to be on the defensive and the extension of the benefits of pasteurization was hindered everywhere by the noisy clamor of those who did not know and who would not believe."

The Public Health Service of the United States has now given to the public "a complete and thorough vindication of pasteurization, proving scientifically that the heat necessary to kill the germs of disease does not impair the ferments necessary to digestion, does not deteriorate the quality of the milk or lessen its food value, does not alter its chemi-

cal or physical qualities and does prevent much sickness and save many lives. \* \* \* When the results of this American investigation are properly grasped by the medical profession and by the officers charged with the protection of the health of nations and communities, it will be held to be a crime to sell milk unless it has been produced under sanitary conditions from tuberculosis-tested herds and delivered uncontaminated in sterilized containers or unless it has been properly pasteurized."

B. R. Rickards, formerly Director of the Boston Board of Health Laboratory, has said that the efficiency of commercial pasteurization he has found to vary from 92.4 to 98.9 per cent. He calls attention to the very great rapidity with which organisms increase in pasteurized milk. For instance, in 24 hours at the temperature of the ice-box the number of organisms in pasteurized milk increased 84 fold, while the number in unpasteurized milk in the same setting increased only one-fourth as much. Pasteurized milk keeps a long time but eventually acquires a strong odor and may reach rather advanced stages of decomposition without turning sour and this, of course, is a pronounced element of danger. In almost every case reported by Rickards the pasteurized milk, although heavily loaded with bacteria, did not decompose until after the unpasteurized milk, taken at the same time, had curdled. It is evident that old pasteurized milk or pasteurized bad milk, although apparently sweet, must be decidedly unfit for the consumption of children. Rickards has also reached the following conclusions:

1. Commercial pasteurization of milk without restriction puts a premium on dirty milk, since dirty

and old milk, otherwise unsalable, can then be put on the market. Pasteurized milk may mean cooked dirt, cooked dung and cooked bacterial products.

2. A false sense of security is conveyed by the term "pasteurized milk." This lack of security may come from either improper pasteurization, the pasteurization of improperly handled milk or improper care of pasteurized milk.

3. The unrestricted pasteurization of improperly kept, old or dirty milk should be prevented by regulations and ordinances prohibiting the pasteurization of milk containing over a certain specified number of bacteria per c.c. Such regulations should, of course, be coupled with a law forbidding the sale of milk above the bacterial limit established.

In the United States three processes of pasteurization are used. These are known as the flash process, the holder process and pasteurization in the bottle. The names practically describe the processes. In the flash process the milk is raised quickly to a temperature of about 160° F. or more, held there from thirty seconds to a minute and then cooled quickly. In the holder process the milk is heated to a temperature of 140° to 150° F. and held there for about half an hour. When pasteurization in bottles is practiced, the raw milk is put into bottles with water-tight seal caps, which are immersed in hot water and held for twenty to thirty minutes at a temperature of about 145° F. In this last way the pasteurized milk is not subjected to the danger of reinfection. On the other hand, the seal caps must be absolutely tight, and this involves increased cost. Whereas the pasteurization in small bottles is by far the best from a consumers and health standpoint, nevertheless the holder process is coming into

greater commercial favor than either of the others. The precautions thrown about the pasteurization of raw milk should be observed in protecting the milk after it is pasteurized. One false step in this handling of pasteurized milk will undo all the good effects of the process.

We do not care to boil all our drinking water, but we do so readily when we know that it is defiled at its source. We should pasteurize milk when we have doubts or qualms in regard to its purity and wholesomeness, but with milk as with water it would be far better for us to remove the *cause* of contamination and eliminate the risk and danger of pollution.

An eminent sanitarian in New York, in his writings and public addresses discouraged pasteurization, because theoretically it does not reach the source of the evil, and is not as good in the end as purification of the milk supply through efficient inspection. However, when this same sanitarian was consulted by a large wholesale dealer of New York, who handles many thousands of quarts of more or less old, dirty milk a day (the best he could get), the expert was confronted by a condition, not a theory, and after mature consideration was compelled to advise pasteurization. Proper and rigidly enforced milk laws would overcome this condition, but if such laws are not made or if made, give no security because of politics, cost of enforcement or inefficient officials, there seems to be no other recourse but the adoption of pasteurization. If milk is pasteurized it should be cared for fully as much as untreated milk—preferably more, for the acid-producing bacteria, nature's danger signal, have been destroyed. Park and Holt have found 100,000,000 bacteria per c.c.

and these mostly spore-bearing, in samples of old pasteurized milk being used for domestic purposes; hence the need of marking the age of milk on every container.

Pasteurization of all the milk supplied to a community may not be desirable. Clean, fresh milk, certified and free from contamination and produced under hygienic and sanitary conditions as they affect cows, dairymen, milk handlers, physical equipment and housings, may not need it. Raw milk, pure and wholesome is preferable, as it is a natural food drink; certain children and invalids may need it, but after all the general public and the buyers and consumers of the average run of milk should be protected, and the poor and those living in the congested quarters of cities should be safeguarded against *that* milk, stale, dirty and uncared for, which forms the bulk of the milk supply of our thickly populated centers. Even if milk is pasteurized, the need of laws or ordinances requiring dating, cooling and reasonable prompt delivery are positively essential for the proper protection of health.

Theobald Smith in 1907 expressed the opinion that pasteurization is the inevitable outcome of the future. He says, "It seems to me that the real difficulty of the present condition is the transmission of specific disease germs which are not easily controlled by any amount of cleanliness, and these specific disease germs, one and all of them, may be destroyed by the average pasteurization."

Sedgwick voiced the opinion of many sanitarians when he stated, "when all is said and done, I agree with Professor Smith that we have got to pasteurize milk. Heated milk is the only safe milk and will always remain the only safe milk for the use of man-

kind. Little by little the idea is spreading that raw milk is apt to be dangerous milk."

Rosenau says, "Theoretically, pasteurization should not be necessary; practically, we find it forced upon us. The heating of milk has certain disadvantages which must be given consideration, but it effectually prevents much disease and death, especially in infants during the summer months."

### **Sterilized Milk**

A distinction should be made between two terms which are often used synonymously, viz.: Sterilization and Pasteurization. The U. S. standards established for dairy products describe sterilized milk as "milk that has been heated at the temperature of boiling water or higher for a length of time sufficient to kill all organisms present," and pasteurized milk is also described most unsatisfactorily as "milk that has been heated below boiling, but sufficiently to kill most of the active organisms present and immediately cooled to 50° F. or lower." By popular usage, boiled milk is sterilized, and heated milk is pasteurized, and both terms unless qualified mean but little and are apt to be very deceiving. To make any liquid or other substance sterile, is to free it from all reproductive bacteria or spores—to destroy all the micro-organisms and all forms of life contained therein or thereon, or make them incapable of reproduction, virility or function. Sterilized milk is milk treated so that all the bacteria have been destroyed. This requires a temperature in excess of that of boiling, for milk contains spores that cannot be killed by boiling. Fleischmann said that sterilization of milk could be obtained by submitting it to the action of continuous steaming for

2 hours at a temperature of 248° F. or for 30 minutes at 266° F. Conn says that in order to destroy bacteria in milk "a temperature of 220° to 230° F. is necessary, and to obtain this the milk must be heated in sealed chambers under steam pressure." He also adds that sterilized milk "is rarely found outside of a bacteriologist's laboratory." It is doubtful if perfect commercial sterilization of milk could be effected, and neither the Fleischmann or Conn suggested temperatures and periods of exposure will produce sterile milk. Alternate heating and cooling or "Intermittent sterilization" would be necessary and when sterility was ultimately obtained, the milk would have lost its virtue as a food drink. Submitting milk to a high temperature is very objectionable, for when so treated the composition of the milk undergoes a certain amount of change which not merely affects its biological but also its physical condition. Rosenau has said that the boiling of milk produces the following pronounced changes:

"Decomposition of the proteins, and other complex nitrogenous derivatives; diminution of the organic phosphorus; increase of inorganic phosphorus; precipitation of the calcium and magnesium salts and the greater part of the phosphates; expulsion of the greater part of the carbon dioxide; caramelization or burning of a certain portion of the milk sugar (lactose), causing the brownish color; partial disarrangement of the normal emulsion and coalescence of some of the fat globules; coagulation of the serum albumen, which begins at 167° F.

The casein is rendered less easy of coagulation by rennin and is more slowly and imper-

fectly acted upon by pepsin and pancreatin. Boiling gives the milk a 'cooked' taste. The cream does not rise well, if at all."

Milk that will not keep indefinitely is not sterilized, and no milk has been commercially treated that does not contain bacterial spores which, in time, will develop and cause its decomposition. Moreover, if such milk were procurable the treatment by heat required for sterilization would make it undesirable as a food for the average adult and positively unsuited for the nourishment of children and invalids. Boiled milk is not sterilized milk and is not to be compared as a food drink with natural, pure, wholesome fresh milk. If raw milk is of questionable quality and a community is in the throes of an epidemic of disease, pasteurized milk and not boiled milk should be used. If pasteurized milk cannot be obtained from a reliable dealer, then the Straus Home Pasteurizer, inexpensive and simple to operate, should be used by the housewife in the home to protect the health of the family.

### **The Grading of Milk**

Milk is one of the few articles of food to which two kinds of standards are applicable and for which two kinds of standards are essential. One of these is the chemical standard by which to judge the food value of milk and has for its prime purposes the prevention of fraud on the part of the dealer and to insure the purchaser's receiving the number of food units for which he pays and the proper balance of the essential food ingredients. The other standard, at times even more important, is that by which to measure the sanitary quality of the milk or the

standard of decency and health of the cows producing it and the dairymen handling it. John F. Anderson, President of the American Public Health Association, has said that "When a farmer has an apple orchard he expects to sell his apples on grade—a higher price for the best, a lower for the others; he never expects to sell all for the same price. It is the same when eggs are sold; they are sold strictly on grade—the freshest and those delivered to the consumer most quickly after being laid, command the highest price, those not so fresh a lower price, and so on; and when the best are mixed with the others the price is that of an inferior grade. When the farmer comes to sell his milk to the dealer, and the dealer to sell it to the consumer, what do we find is the usual practice? As a rule, the good milk is mixed with the bad and sold for one price and that price is generally less than the price the good milk should bring. The bad milk should not be sold at all."

The one quality, one price practice of selling milk is unfair to decent, careful and honest farmers, puts a premium on slipshod methods and encourages the careless, shiftless farmers in the production of dirty and unsafe milk.

"It is certainly a fact that there are persons who either through ignorance or apathy do not care whether the milk they buy is clean and safe or not. To them all milk is the same. The majority of milk consumers, however, want clean, safe milk. They want a milk that is free from disease germs and that they can give with confidence to their children. They want the best milk, but on account of the operation of the 'one-quality one-price' system they cannot

distinguish between the clean, safe milk and the dirty, unsafe milk. They have no difficulty, however, in getting the best quality of eggs when such are wanted, as eggs are not sold under the 'one-quality one-price' system but are sold on grade. When those of the community who value decency and safety become sufficiently aroused to demand that a distinction be made between the good and the bad milk, decent dealers will be found who will provide a safe milk at a reasonable price."

When milk is sold on grade it will not be long before Health Inspectors will be able to prohibit the worst grades and gradually eliminate all bad milk from the market by making the acceptable requirements more and more drastic in the interest of public safety. Anderson has truly said that "There can be no question that the production of so-called certified milk has been one of the biggest factors in the improvement of the general milk supply, and this in spite of the fact that certified milk is less than one per cent. of the total milk supply; but wherever certified milk is sold, that place at once has forced upon it grades of milk, and grades of milk mean that the milk supply is composed of milk of varying degrees of excellence and sold for prices varying with its sanitary quality. The grading of milk and the establishment and enforcement of standards enable us at once to distinguish clean milk from dirty milk, the clean farmer from the dirty farmer, the clean dealer from the dirty dealer, the consumer of clean milk from the consumer of dirty milk. This system puts a label on each grade, so that the buyer may choose; it breaks up the 'one-quality one-price' system and creates several qualities at several

prices; it stimulates the production and sale of better milk."

The New York Milk Commission has done splendid work in an effort to directly improve the milk supply of New York City, and indirectly that of every community in the United States. Their report states that "While public health authorities must necessarily see that the source of supply and the chemical composition should correspond with established definitions of milk as a food, their most important duty is to prevent the transmission of disease through milk. This means the control of infantile diarrhoea, typhoid fever, tuberculosis, diphtheria, scarlet fever, septic throat infections, and other infectious diseases in so far as they are carried by milk. There is no escape from the conclusion that milk must be graded and sold on grade, just as wheat, corn, cotton, beef, and other products are graded. The milk merchant must judge of the food value and also of the sanitary character of the commodity in which he deals. The high-grade product must get a better price than at present. The low-grade product must bring less."

The Commission recommended that milk shall be divided into three grades which can be briefly summarized as follows:

Grade	Nature	When sold Bacteria per c.c. to be less than	Maximum bacterial content per c.c. of raw milk before pasteurizing
A.	Raw	100,000	
A.	Pasteurized	10,000	200,000
B.	"	50,000	1,000,000
C.	"	50,000	Over 1,000,000

It was recommended that Grade C, if used at all, should only be used for cooking and manufacturing purposes. It is said that more and more of the milk supply of New York City is being turned to "Grade A Pasteurized Milk," a good safe milk which sells for 10 and 11 cents per quart and is free from pathogenic germs and low in bacterial content, if used when fresh. Such milk is obtained from cows free from disease, as determined by physical examination by qualified veterinarians.

No raw milk, except Grade A should be used at any time and the cows from which this milk is obtained should pass the tuberculin test and all the dairy employees handling the cows and their milk should pass the medical inspection of a qualified physician before such milk should receive the designation "Grade A."

To improve the quality of milk in any community it is recommended that the reports of all laboratory analyses and investigations of milk made by departments of health be regularly published and that the sale of mislabeled or misbranded milk be punished with suitable penalties.

Milk should not only be graded, based on its sanitary and hygienic properties, but on its food value also. Abnormal or adulterated milk with desirable low bacterial content, but with undesirable low food value should not sell for the same price as good rich milk likewise low in bacterial content. Skim milk does not sell for the same price as raw milk containing its natural fat or cream, and there is no reason why a milk with 2 per cent. of fat should command the same price as one containing 4 per cent. or twice as much fat. A

dairyman may be quite ethical in unconsciously selling for the full market price, pure but abnormal milk—the natural product of lactation of his cows which, however, are very poor milk givers—but there is no reason why the consumer should pay even an honest farmer nine or ten cents per quart for milk which carries only six cents of nourishment based on market values. As far as food value is concerned, the honest farmer with cows secreting milk of abnormal low food value gives the consumer no more for his money than the unscrupulous dairyman who deliberately adulterates his milk; in one case the farmer may be both ignorant and unfortunate, but in the other he is criminal. The variation in the composition of milk is due to the breed and individuality of cows, the period of lactation, feeding, mode of life and environment, health and peculiar physical characteristics, etc. So unsatisfactory is the present custom of buying milk by measure, without regard to its food value, that important changes appear to be inevitable in the near future, and milk will probably be bought not only by grade determined by its bacterial content, but also by food value determined by its analysis.

If we value milk in direct accordance with its calorific or food value and if we consider as a standard milk, worth say 9 cents per quart, that milk containing the minimum fat and other solids as required by the New York Milk Commission, then the following table will show how the food value of milk varies with its composition.

The range in quality and composition of milk that has been placed on the market is even greater than that covered by the following table:

No.	Fat	Milk Sugar and Protein	Food Value per 100 grams	Relative Sales Value. Cents per quart
1	2.25	7.8	52.9	7.65
2	2.75	7.8	57.5	8.32
3	3.25	7.8	62.2	9. (Standard)
4	3.75	7.8	66.9	9.68
5	4.25	7.8	71.5	10.34
6	3.25	5.8	54.0	7.81
7	3.25	6.8	58.1	8.4
8	3.25	8.8	66.3	9.59
9	3.25	9.8	70.4	10.18
10	1.00	4.0	25.7	3.72
11	2.25	5.8	44.7	6.47
12	4.25	9.8	79.7	11.53
13	7.00	12.0	114.3	16.54

Sugar, fat and nitrogenous matter are not of equal commercial value as food substances. Koenig's axiom was that protein, fat and sugar have relative money values of 5, 3 and 1. Milk sugar is more valuable as a food than cane sugar, as it is more easily digested. Milk fat is also a valuable and readily assimilated fat, so let us assume (merely to illustrate the principle) economic values of 10, 7 and 3 for the protein, fat and sugar in milk. On this basis of computation, the standard New York milk (No. 3 as per table) with 3.25 per cent. of fat, 0.7 per cent. of ash, 4.6 per cent. of milk sugar and 3.2 per cent. of protein, with 11.75 per cent. of total solids has a monetary value of

Fat	$3.25 \times 9.3 = 30.2 \times 7 = 211.4$
Sugar	$4.6 \times 4.1 = 18.9 \times 3 = 56.7$
Protein	$3.2 \times 4.1 = 13.1 \times 10 = 131.0$
	<hr/>
	62.2                  399.1

If the milk has a market value of 9 cents per quart, then 399.1 monetary units is worth 9 cents, or 44.3 units per cent.

Suppose now milk No. 13, with 6 per cent. of sugar, 6 per cent. of protein and 7 per cent. of fat was available, then on this basis of computation, the monetary value is

Fat	$7.00 \times 9.3 = 65.1 \times 7 = 455.7$
Sugar	$6.00 \times 4.1 = 24.6 \times 3 = 73.8$
Protein	$6.00 \times 4.1 = 24.6 \times 10 = 246.$
	<hr/>
	114.3      775.5

and 775.5 units divided by 44.3 units for each cent of market value, suggests that this milk is worth 17.5 cents per quart. Milk No. 10 considered similarly shows a value of

Fat	$1.00 \times 9.3 = 9.3 \times 7 = 65.1$
Sugar	$2.00 \times 4.1 = 8.2 \times 3 = 24.6$
Protein	$2.00 \times 4.1 = 8.2 \times 10 = 82.0$
	<hr/>
	25.7      171.7

$171.7 \div 44.3 = 3.87$  cents per quart. Research into the correct relative economic value of milk constituents will probably modify the numerals herein used, but the principle used to illustrate the need of purchasing milk based on its food value, is incontrovertible. It is quite evident that water is not worth 9 cents per quart; it can be considered in foods as having no market value whatever. Milk is about 87 per cent. water and the larger the water content of milk the less the value of the milk as a food. It is also known that cream sells for many times the amount realized from the sale of milk, generally around 7 to 1, so a milk containing twice

as much fat as another, has a constituent therein that commands in the market seven times the price of the average substance with its part cream, protein and sugar that it is displacing. To obtain a simple, practical and easily applied system of grading milk by chemical composition, with due respect to food value, we might consider only the milk solids—or the residue when all the water is evaporated—and the fat, which can be readily separated from whole milk. Giving milk conforming with the New York Milk Commission minimum standard a market value of 9 cents per quart, and considering fat twice as important in milk as sugar, nitrogenous substances and mineral matter, we obtain the formula  $2 (3.25) + 8.5 = 9$  cents, or 1.67 units per cent. Assuming the ash or mineral content of all milks as 0.7 per cent., then milk No. 13 is  $2 (7.) + 12.7 = \frac{26.7}{1.67} = 16$  cents per quart and milk No. 10 is  $2 (1) + 4.7 = \frac{6.7}{1.67} = 4$  cents per quart. Comparing the three methods of computation we find:

Milk No.	Relative Values		
	(1)	(2)	(3)
	Based on Calorific or food value	Based on food value and relative market value of constituents	Based on simplified formula, which generally considers both 1 and 2
	Cents per quart	Cents per quart	Cents per quart
3 (Standard)	9.0	9.0	9.0
13	16.54	17.5	16.0
10	3.72	3.87	4.0

This gives unusually uniform results and suggests the use of the simplified formula and method of

*SALES VALUE OF MILK  
BASED ON ITS CHEMICAL COMPOSITION.*

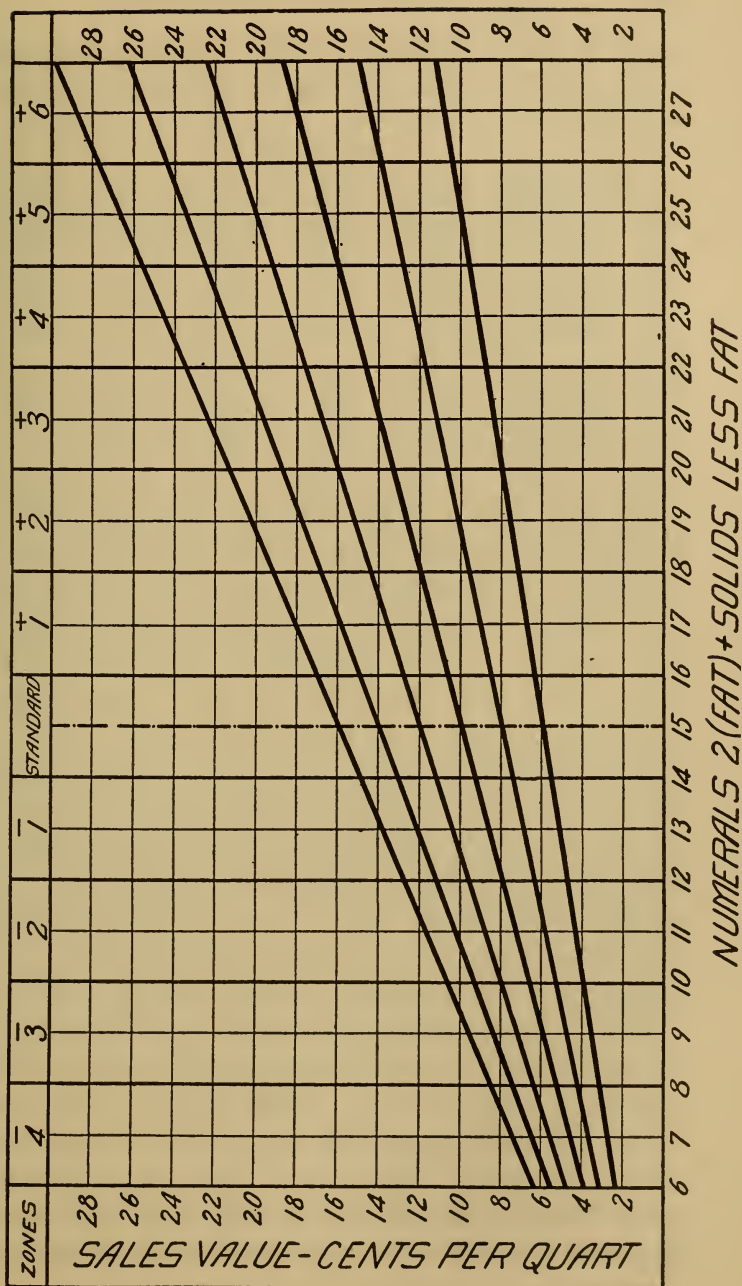


FIG. 18.

computation. Grades of milk for commercial purposes could be based on Numerical Zones somewhat as follows:

Grade	Numeral twice Fat+Solids less Fat	Relative Sales Value per Quart				
		If standard 8 cents	If standard 9 cents	If standard 10 cents	If standard 11 cents	If standard 12 cents
+5	24.1 to 26	13.5	15.0	17.0	18.5	20.0
+4	22.1 to 24	12.5	14.0	15.5	17.0	18.5
+3	20.1 to 22	11.0	12.5	14.0	15.5	17.0
+2	18.1 to 20	10.0	11.5	13.0	14.0	15.0
+1	16.1 to 18	9.0	10.0	11.5	12.5	13.5
Stand- ard	14.1 to 16	8.0	9.0	10.0	11.0	12.0
—1	12.1 to 14	7.0	8.0	9.0	9.5	10.5
—2	10.1 to 12	6.0	6.5	7.5	8.0	9.0
—3	8.1 to 10	5.0	5.5	6.0	6.5	7.0
—4	6.1 to 8	3.5	4.0	4.5	5.0	5.5

Appended is a diagram which graphically shows the relation of sales value of milk to its composition, varying with different market prices for the average or standard commodity. At the present time the only grades of milk considered commercially are those based upon bacterial content or the sanitary condition of milk. At some time in the future all milk will be required by the State and Municipalities to conform to drastic standards in regard to bacterial content, sanitary and hygienic properties. The state or cities will absolutely control the milk supply of its people just as the municipal authorities either own or control the water supply. The purity of a water supply is vital, but the purity of a milk supply is infinitely harder to obtain, is just as important for adult life and much more essential for the health and well being of the little ones. When all milk permitted to be sold in any community is pure, fresh, free from all pathogenic germs and low in bacterial content, then milk can be properly graded and sold, based on its food value

and one standard will take the place of the two that we are compelled to consider to-day.

In the meanwhile, milk should be sold with due respect to its age, and the value of milk should depreciate with age, as is the case with eggs and other perishable foods. Milk of a certain age should be condemned whether considered sweet, sour or undergoing decomposition. Every milk bottle should be clearly marked with the date and time when the milk was taken from the cow, also the date and time of pasteurization, if any, the temperature high and low used, and the period of time that this milk was subjected to these temperatures before being handled for delivery to the trade, and this in addition to its grade designation, which should be determined not only by the bacterial count, but also by its composition, calorific value and relative commercial value as a food drink.

### **Certified Milk**

The Medical Milk Commission of Essex County, New Jersey, composed of physicians from Newark, Orange and Montclair, N. J., was organized April 13, 1893. This was a pioneer Commission, formed with the object of establishing correct clinical standards of purity for cow's milk in the public interest, of being responsible for periodical inspection of dairies under its patronage, of arranging for chemical and bacteriological examinations of the product and the frequent scrutiny of the stock by competent veterinarians. The term "Certified Milk" originated with this Commission and the word "Certified" was registered in the U. S. Patent Office on October 16, 1904, the object being to protect it from being degraded by dairymen not working

under the direction of a medical commission, organized to supervise and influence dairy operations for clinical purposes and the public health and well-being.

Dr. Henry L. Coit, of Newark, N. J., who has been called "the father of certified milk," gives the following definition of certified milk:

"Milk from a lower animal which has been certified by a medical milk commission appointed by a medical society, which certification is the monthly authorization for the commercial use of the term and which certificate is based upon the commission's investigation relative to the production of the milk showing that it conforms to the standards of quality and purity for certified milk and the methods and regulations for the production of certified milk, which standards of quality consist of a fresh milk, unchanged by either heat or cold, less than 24 hours old when sold, and which contains not less than 12 per cent. of total solids, with not less than 3.5 nor more than 5.5 per cent. of fat, to which have not been added any other food principle, chemical substance, or preservative, which standards of purity for the milk consists of the lowest possible bacterial and dust-dropping content consistent with the highest possible practice of dairy hygiene, provided that the average numerical contamination is not above an average weekly count of 10,000 bacteria per cubic centimeter, and from which milk every known method has been employed to exclude pathogenic micro-organisms, and which standards of purity are safeguarded by a medical guaranty of the health and personal hygiene of every employee handling the milk and by a veterinary guaranty that the milk herd will not be a carrier of any dis-

ease to those using the milk for food; which methods and regulations for the production of certified milk are carried on in conformity with those adopted by the American Association of Medical Milk Commissions and are changed from time to time as the action of this association modifies the technique for the attainment of the standards of quality and purity for certified milk growing out of improved methods and regulations for its production."

Ernest Kelly of the U. S. Department of Agriculture, investigating in 1913 the extent and practice of Medical Milk Commissions, reports that 66 Commissions had been formed, the most active period in this movement being 1906 to 1910, the zenith being reached in 1908; from 1 to 20 dairies supply each Commission with milk, the amount of milk certified by each Commission varying from 75 to 10,750 quarts per day. It was estimated that the total production of the 126 certified dairies aggregated 25,000 gallons per day and it is interesting to note that 20 of the Commissions formed had discontinued, in 1913, the certification of milk. Kelly estimated that from 1907 to 1913 the production of certified milk increased 300 per cent. but from his statistics it appears that practically all of the increase was realized during the first four years of this period and the demand is not materially increasing. "In nearly all localities it is a hard fight for the Milk Commissions to educate the consumers to the consumption of certified milk. There are two reasons for this: First, it has been found that there is a general apathy among consumers as to the purity of their supply. This would hold good as well with certified as with market milk. Another reason is that the price of certified milk is considerably higher

than that of market milk and it is hard to get people to pay the extra cost."

If the consumption of certified milk is increasing, the increase is very slow and at the present time only about one-half of one per cent. of the total milk supply in this country is certified.

Government statistics compiled in 1913 indicate that the price of certified milk to the consumer varies in different cities from 10 to 20 cents a quart, the average price for all cities being about 14.2 cents. The price of ordinary market milk in the same cities varies from 5 to 12 cents a quart and averages about 7.8 cents. Certified milk therefore sells for an average of 6.4 cents a quart, (or 82 per cent.) more than market milk. As a rule, where the price of market milk is low, the price of certified milk is also comparatively low, although this does not hold true in all cases.

It was found in 1907 that the average price of certified milk was  $12\frac{1}{4}$  cents a quart, and the average price of market milk was  $7\frac{1}{4}$  cents a quart. It will therefore be seen that while the average price of market milk has increased about 0.6 of a cent a quart during a six-year period, the average price of certified milk has increased about 2 cents a quart. And yet there are Milk Commissions who report that the demand for certified milk is good but dairymen are not willing to supply it. The states of New York, New Jersey, Kentucky, California and Michigan have passed laws regulating the sale of certified milk thus protecting and legalizing the use of the term "certified," a word which notwithstanding its registration is being abused in the trade. We are told by government investigators that there are a few dairymen who sell their

product under the name of "certified milk" who have no connection with milk commissions. These, in some cases, certify to their own product, and in others, samples are sent to a State experiment station or to some local chemist or bacteriologist for examination. Some dairymen in this class supply a very creditable product. There are others whose milk is of only ordinary quality. The samples for analysis are usually taken by the dairyman himself from milk fresh from the cow and immediately iced and sent to the analyst. The analyst reports his results and the dairyman uses them to advertise his product. This cannot be looked upon as anything but a deception, as the consumer is given to understand that this is the analysis of the milk as it is delivered to him daily. It is only when scientific milk commissions have been organized and a plan of education has been started to create a demand for sanitary milk particularly designed for infant feeding, that there arises any danger of an impure milk being put on the market under such a label. It is manifestly unfair, therefore, that after a commission, serving in the interest of the public, has created a feeling that "certified" milk means a safe, clean milk for infant feeding, some unprincipled dairyman should be able to prey on the ignorance of the public and supply an unsafe milk at a high price. Steps should be taken by the milk commissions or by the city or State officers to prevent such practices. Where milk is an article of interstate commerce, the national pure-food law covers misrepresentations of this character.

No milk should be permitted to be sold as certified milk unless the container shall be clearly marked with the name and address of the Com-

mission certifying it and no Commission should be permitted to supervise the production of milk and pass upon its quality unless it be an incorporated body of scientific, unbiased men, authorized by the State and accepted or endorsed by the community; these men should be duly qualified by character and training to acceptably perform their important tasks in the interest of public health and they should be paid a nominal sum for their services by the community and dairies which they serve.

Milk Commissions should not be under the control of National, State, County or City Medical Societies or Associations. The New York State law in regard to certified milk requires that the Milk Commission be "appointed by a County Medical Society, organized under and chartered by the Medical Society of the State of New York." This is unfortunate, for knowledge and conscientiousness are the prime essentials of qualification and not professional endorsement by any exclusive body. There are some practicing physicians, such as Dr. Coit, of Newark, N. J., who have done splendid work in the crusade for safe milk, but the majority of general practitioners, whereas they may in a measure appreciate the importance of a sanitary and wholesome milk supply, are apt to be technically or practically unfitted to have control over the inspection and certification of the milk consumed by the community in which they reside. They are generally incompetent to advise any dairymen in regard to practical problems and are almost invariably incapable of making scientific investigations or analyses themselves or of devising ways and means of obtaining reliable comparative results economically and promptly. The real work

that has been done in the past, in the study of milk, has been performed by chemists, bacteriologists, analysts, college professors, sanitary and hygiene engineers and technically trained dairymen and agriculturists and the actual practical supervision of dairies and the products of dairies will have to be in the hands of chemists, bacteriologists, analysts, veterinarians and engineers if the people are to be efficiently and intelligently served. The New York Milk Commission was composed of competent men of national reputation, eminently fitted to perform the task intrusted to them. This Commission of 17 men consisted of 5 chemists, 6 professors, most of whom were chemists and bacteriologists, 1 consulting sanitarian and 5 health officers from various parts of the country—but no general practitioners. The badge M.D. does not make a man any more fitted to solve a milk problem than the label M.E. and as a general proposition both the water and the milk supply of any community might be better entrusted to trained engineers and chemists than to physicians.

The Medical Milk Associations which certify milk, have no rigid national standard and milk may be certified in one locality carrying 100,000 bacteria per c.c., whereas, in another community the maximum permitted is 10,000. The government investigations of 1913 showed that certified milk had a fat content varying from 3.2 to 6 per cent., the average being 4.3 per cent. for the country; the total solids varied from 11.74 to 14.5 per cent. with an average of 13 per cent. In regard to the age of certified milk when delivered, it was found that whereas some milk was delivered to the consumer when 6 hours old, other milk was 48 hours old when

it reached the market; the average age when delivered was 20 hours. As some milk will not be used until 24 hours after its delivery, it is evident that some certified milk is 3 days old when consumed.

As would naturally be expected, certified milk, if it conforms with low bacterial content requirements, will keep sweet for a long time. The theory that clean milk should possess good keeping qualities works out in practice. Kelly says that certified milk of an unusual quality has been taken on an ocean voyage and not only brought back in good condition but kept sweet until 30 days old. In fact, it is now a common practice for people when crossing the water or taking a long land journey with infants to take several small cases of a special grade of certified milk with them. They are then reasonably sure of having a supply of sweet milk for several days.

A number of certified milk dairies in the United States sent exhibits of milk to the Paris Exposition in 1900. Most of this special milk kept perfectly sweet for two weeks and in some instances 18 days after being bottled. Hermetically sealed bottles were used and the milk was, of course, most carefully packed in ice for shipment.

The milk and cream contests at the National Dairy Show in recent years have demonstrated the remarkable keeping qualities of specially prepared or selected certified milk. Some of the samples submitted have reached Chicago from the States of Washington and California. Though these samples have some of them been over a week old when plated, they have shown remarkably low bacterial counts. After this milk has been judged it has

been kept in cold storage, and some has been consumed over two weeks after its production, when it was found quite palatable. It is not advisable, however, to use old milk even though it may taste sweet. Serious consequences may result due to bacterial growth which cannot be detected in the flavor of the milk.

The knowledge that good certified milk will keep for a long period of time has caused much trouble and distress in recent years and has been responsible for much indifference on the part of milk handlers, hotels, ship and train stewards, etc., in regard to the age of milk served their patrons as wholesome certified milk.

Milk with extremely low initial lactic acid bacterial content, if kept on ice, may act somewhat like pasteurized milk for a certain period of time; it may show no indication of souring, due to the apparent non-activity of lactic acid bacteria, but other micro-organisms may thrive therein and the milk though sweet become unwholesome and unfit for consumption. Certified, pasteurized or raw milk should be consumed when fresh and all old milk is dangerous no matter what it is called and no matter what its treatment may have been. City ordinances or state laws should be enacted prohibiting any dairyman, dealer, hotel, railroad or steamship company selling to any customer or patron milk, whether certified or not, that is over 72 hours old. The practice of dining car stewards taking on milk at one end of their run when they could obtain equally good milk at either end, is inspired by ignorance but is nevertheless a crime against the little travellers whose parents are deluded into a sense of false security by the words "certified milk."

There is a possibility that the use of certified milk may at times do positive harm because of the confidence that the name or designation inspires in the lay mind. The purchaser pays more for the milk and knows that it has been obtained under sanitary conditions. He imagines that he is obtaining guaranteed milk certified as being pure, wholesome and safe—which is not so. No raw milk, whether certified or not, can be guaranteed as being free from disease germs or other contamination. The certifying Commission can certify only as to the general condition of the dairy that produced the milk but never to any particular bottle of milk or day's milking. It sometimes happens that certified milk is of no better character than ordinary raw market milk, sometimes it is not as good and epidemics have been caused by certified milk. The exclusive use in the home and when traveling may lull one into a false sense of security and herein lies one of the dangers of certified milk, which can never mean under the present existing *modus operandi*, guaranteed and tested safe milk. Certified milk is on the average far safer, cleaner and purer than raw market milk, for it is the product of dairies which pay attention to the laws of hygiene and which have better kept and healthier cows, cleaner stables, covered milk pails, more careful cleansing of utensils, cleaner and healthier dairymen, etc., and every farmer who pays attention to the requirements of milk commissions in order to obtain a certificate from such a Board must of necessity produce an improved grade of product. Fine, modern, clean cow barns will not, of themselves, result in sanitary milk, for the human element is of prime importance and North's experiments, which re-

duced the bacterial count of milk from 5,000,000 to 800 by merely changing the milkmen, have opened up a wide field for thought and investigation. Referring to his Pennsylvania tests Dr. Charles E. North, the noted sanitarian has said:

"After I had trained some milkman how to milk I was challenged by folk in Pennsylvania to prove that the guilt lies with the milkman. I offered to bring in a traveling army of milkmen, take over a lot of farms, operate them myself and get pure milk.

"The farms were at Kelton, Pa. The farmers wanted to know what they were to do—build new barns, buy disinfectant, put in new cooling plants or what. I said they were to do nothing at all. I moved my men in at noon, after the old milking system had been tested for a week for bacteria on each farm. One of my men told me he was sure he was a failure because the farmer whom he displaced insisted on sweeping a lot around the barn while he milked. Sure enough he was. His bacteria count was up to 60,000, but even at that it was better by 3,550,000 than the farmer he displaced.

"Boiling hot water did it. All my men brought with them was a milk bucket each, the bucket built with a small mouth no bigger than that with which the calf has always obtained Grade A milk. Then they scalded in boiling water everything connected with the milking process. They insisted on quiet in the barns and freedom from feeding even, as this sent clouds of dust into the air.

"The bacteria count in the morning on the first farm was 1,830,000. My milkman reduced it at night to 3,300. The bacteria count in the morning on another farm was 5,000,000. My milkman reduced it to 4,100. On a third farm the count in the morning was 4,000,000 and at night it was 1,600. The lowest any of the unskilled milkmen ran was 1,450,000. The highest any of my milkmen ran was 7,000, with the one exception where the anxious farm owner interfered and forced a count of 60,000 for his pains with the dust-raising broom."

The results attained by these interesting tests should not, however, cause any lessening of sanitary supervision of cow barns, cattle, water, utensils, etc., for the Government reports show that 94.5 per cent. of the milk and milk product plants in this country are unsanitary and much of their product is "filthy, disease-breeding and unfit for human consumption."

It is imperative that business principles be closely applied in the production of sanitary milk so that the price may be kept as low as possible to the consumer and still let the dairymen operate at a profit. Intelligence and care should be displayed by sanitary milk producers to the economic feature of their business as well as to the sanitary side. Kelley's Certified Milk Investigation of 1913 showed that one-half of the producers of certified milk claimed that the business was profitable, the other half affirming that notwithstanding the increased price obtained, it was unprofitable. There is something radically wrong when one dairy produces certified milk and sells at 12 cents per quart, making an acknowledged good profit and another dairy producing similar milk (and no better) claims that the business is unprofitable when they obtained 20 cents per quart—or 67 per cent. increased price—for their product. Business men, commercial analysts and efficiency engineers as well as sanitarians, bacteriologists, chemists and physicians are apparently needed on Milk Boards if the best interests of the people are to be served, for the economic phase must not be permitted to handicap, through ignorance and unscientific manufacturing and business methods, the progress of human well-being. Figures prepared by the U. S. Dept. of Agriculture show the great possibility for economic improvements in certified milk distribution. One dairyman received only 6.5 cents per quart for his milk, but the consumers paid 12.5 cents; the freight was 1 cent and the middlemen obtained 5 cents per quart for distribution and profit in handling. Many cases are reported where the distributor obtained 3 to 5 cents per quart for his services. The testimony

before the Wicks Legislative Committee of New York State, July, 1916, brought out the fact that a farmer received 8 cents per quart for milk which was sold by New York dealers for 15 cents. Another received 6 cents per quart for milk which cost him 3.2 cents, and it was sold in New York for 10 cents. The whole question of milk distribution is impregnated with economic possibilities and the day may come when municipal authorities will dictate or control milk routes so that instead of seeing eight milk wagons competing for the milk business in one street of a small city, there will be one channel of delivery just as there is one water supply and one medium for postal delivery. When all milk is produced under drastic inspection and rigid laws and sold based on its food value and this only when fresh and wholesome, all milk will be sanitary and truly "certified"; the product of dairymen being standardized, the consumer will be quite willing to obtain standard milk from A or B and each will have a milk route with the same number of customers as at present, located in from a half to one-twentieth of the area now daily traversed. Distributing companies under municipal control would be a still greater improvement, for the dairyman would simply deliver his milk to the distributing depots where it would be graded for commercial value and fat content. Thus would a careful mother be enabled to specify and buy truly certified milk of a certain required fat content, not too rich with cream to upset the digestion of her little one, and in paying for such milk she would be charged less than the standard price instead of far more, as is the case at present. There is no way now of

such a mother knowing exactly the composition of the milk that she is buying.

The Milk Commissions of the country composed exclusively of physicians have been federated into a National Association known as the American Association of Medical Milk Commissioners. It is stated that the fundamental object of this Association is to bring about the uniformity of standards and their perfection—a worthy object. Each Milk Commission organized, however, must be “appointed by a representative Medical Society and act under its auspices and for it.” The physicians apparently appreciate their inability to handle this matter of themselves, for the physicians, i. e., the Medical Milk Commissioners who are members of a Medical Society “should designate a veterinarian, a physician, a chemist and a bacteriologist to enforce its methods and standards.” The physicians seek to control, but others will do most of the work. The veterinary, a most worthy and important professional specialist, who should have supervision over animal health and general welfare is subordinated to the physicians, but being in the strata of professional greatness immediately below that of the human doctor, he is held responsible by the physicians for the hygiene and sanitation of the dairy, i. e., ventilation, purity of water supply, cleanliness of dairymen, cleaning and sterilizing of utensils, etc., work for which he is not by training fitted. The medical officer “shall be a physician in good standing and authorized by law to practice medicine.” He should see that “no person shall be employed who has not been vaccinated recently.” This will probably be followed later by requirements that each worker in the cow barns and dairy

must be periodically subjected to the injection of serums for "every ill to which mortal man is heir," for doctors must live, fads are revered and hobbies are ridden to death. Medicine was founded on superstition and the power of suggestion, and to-day these forces still hold sway. Notwithstanding the splendid men found in the medical profession and the great benefactors to humanity among the ranks of the conscientious physicians and surgeons, the certification of milk should not be left to any Medical Society, or the control of any food or other needed and necessary commodity placed in the hands of an exclusive professional society or organized body of men banded together for their mutual protection and benefit. The clannishness and shielding "professional etiquette" of doctors are proverbial. The world's problems need to be handled by science; conditions should be probed by analysts and the cry of the hour is for truth, for cold immutable facts on which the structure of progress for the well being of society can alone eternally rest.

### **Inspected Milk**

Several of the medical milk commissions are supervising and granting their official approval to the production of a special grade of milk which is termed "inspected milk." This milk does not conform to all the requirements for certified milk but is relatively of a fairly good quality and is probably much safer than the ordinary market milk of most cities. It is usually demanded that the cows kept for the production of this milk be free from tuberculosis and that the bacterial count be under 100,000 to the cubic centimeter.

Inspected milk is a sort of second grade certified milk, and the term is supposed to be limited to comparatively clean raw milk from healthy cows, which are required to be fed, watered, housed and milked under good conditions but not equal to those prescribed by the Milk Commission for certified milk. It is expected that all persons who come in contact with the milk must exercise cleanliness and be free from any disease liable to be conveyed by the milk. The milk is generally delivered in sterilized containers and is supposed to be kept at a temperature of not more than 50° F until it reaches the consumer. The Milk Commissions, in officially endorsing a grade of milk not worthy to be rated as certified milk, maintain that by so doing they are inaugurating a school for dairymen and that producers of inspected milk will ultimately be trained to produce certified milk. The principal point of difference between inspected and certified milk is the bacterial count. Bacteria in milk are primarily due to filth, unsanitary surroundings and methods and lack of cleanliness and decency on the part of the operatives. If a Milk Commission require not more than 10,000 bacterial count for certified milk and 100,000 bacteria per c.c. for inspected milk, of the same age and temperature treatment, then they are willing to permit ten times as much product of filth and contamination in inspected milk as in certified milk, whereas, as a matter of fact any milk rightly obtained, under proper sanitary surroundings and handled in harmony with sanitary laws by careful, cleanly and healthy people, should never show more than 5,000 bacteria per c.c. when delivered to the consumer or one-half of the

bacterial content permitted by the most drastic of the Medical Milk Associations. Inspected milk does harm inasmuch as it makes some people believe that it means the best milk obtainable under rigid requirements and the supervision of reputable authorities, whereas, in reality it means practically nothing, as barn, cow and employee inspection is perfunctory and milk analysis means but a very occasional bacteriological test and that probably on selected milk. Legal steps should be taken to prevent the indiscriminate use of the English language by Medical Milk Associations, dairymen and others; for such terms as "Inspected Milk" deceive and in conveying an absolutely erroneous impression, do positive harm to the customers and build up (generally under the protection of a medical milk commission) a lucrative business for an unscrupulous dairyman who is too indifferent to the public good to adopt sane, sanitary and hygienic measures in the handling of his cows and the production of milk. Or else the dairyman is not willing to ice his milk and deliver it fresh and regularly; in this case a high bacterial count will be in evidence, due to age and improper treatment after milking. If the milk is "inspected milk" a milk commission stands sponsor for a dairyman who violates the first principles of milk treatment in storage, transportation and distribution.

The New York Milk Committee apparently appreciated this fact, for they declined to consider any grades of milk except the best procurable raw milk, their B and C grade having to be pasteurized and the bacterial count limited to a maximum of 50,000 per c.c. when delivered to the consumer.

**Mothers' Feeding and Infants' Milk Depots**

The increasing complexity of community life, with its artificialness and attendant evils, has had a pronounced influence in the reduction of natural maternal feeding of infants and at the same time has rendered, in our large cities and congested districts, a suitable supply of wholesome substitute food more difficult to obtain. The problem to-day for the proper feeding of infants is two-fold: *First*, mothers should be taught that there is no substitute for mother's milk even approaching in goodness, suitability and safety that which nature has decreed should be used for the nourishment and development of the young. There is no form of animal milk with the same composition as mother's milk, as there is no form of animal life similar to that of man. Any milk fed direct from the breast of a healthy female mammal to her offspring is sterile, but milk taken artificially, handled, subjected directly and unnaturally to the influence of atmosphere, temperature, transportation, etc., cannot be sterile; such milk is a magnetic feeding medium for bacteria and must of necessity ever be a menace to the health of the young, especially when used during warm weather, i. e. during conditions favorable to the rapid development and multiplication of bacterial life. Any mother who is physically fitted to nurse and feed her child at the breast and does not do so, is committing a crime against an innocent child, violating universal law, perpetrating an outrage against society and setting at naught the well being of the race. Educational measures are therefore demanded for the restoration of the function of the female breast.

*Second.* For the children of mothers physically incapable of nursing their offspring at the breast, and for children of mothers who refuse to assume the responsibility and natural duties of motherhood, it is necessary that milk from some other mammal be obtained that is relatively pure and wholesome and that can, to a great degree, be made adaptable. The only source of supply available in quantity to-day in this country, is the domesticated cow, and although there may be milks that are a better substitute for human milk than is cow's milk, we are compelled for the present to use cow's milk or some modification of natural cow's milk whenever mother's milk is not available for the feeding of an infant. A wholesome supply of cow's milk is of vital importance for children deprived of nature's food and the reduction of infant mortality in those sections of the country that have inaugurated a campaign of sanitary milk for children, is most striking. The greatest "Slaughter of the Innocents" in the history of all peoples, has been the persistent diabolical and wanton destruction of infants and young children from the use of dirty, old, germ-laden cow's milk. When such milk is fed to young infants who should receive their nourishment at the human breast, the mortality is frightful, but children who have graduated from the breast and use cow's milk with other substances as a food, are likewise peculiarly susceptible to disease lurking in unsanitary and old milk; the younger the child, however, the greater is its physical sensitiveness and vulnerability. Dr. Coit, when he formulated his plan for the production of a certified milk for clinical purposes, was inspired by the meritorious determination that something constructive must

be done to save the lives of innocent babies. The same general worthy motive gave birth to the Milk Dispensary, the "goutte de lait" which sprang into existence, not to give good milk at a high price to the children of careful parents who can afford to pay well for it, but to educate the poor and supply milk that will reduce the excessive infant mortality that "civilized" conditions and an artificial mode of life have inflicted upon the families of the poor. The Infants' Milk Depots had for their primary object the encouragement of maternal feeding and when this was impossible, they sought to supply a safe milk to meet the peculiar need of the infant. The first institution of this character in the United States was opened by Dr. Koplik at the Eastern Dispensary, New York; but the greatest work among the poor, to overcome milk evils, has been performed by Nathan Straus whose splendid efforts and advocacy of pasteurization to reduce the danger of infection from dirty milk, met with the pronounced and organized opposition from physicians and medical associations—a not unusual experience for progressive laymen. It is interesting to note that Straus has long since been vindicated in his fight with the medical profession and he did splendid, noble work saving the lives of babies when physicians were theorizing and arguing that he was threatening the ultimate well-being and vitality of the poor peoples, whose children's lives he positively saved. Some Infants' Milk Depots pasteurize milk and some strive to obtain sanitary raw milk and modify it to suit the needs of the young members of the human family. The following formulae are in use at the Straus Milk Depots in New York;

	1	2	3	4	5
	ounce	ounces	ounces	ounces	ounces
Milk,	96	64	64	21 1/3	16
Cream (16%)	—	—	—	10 2/3	4
Lime Water,	—	4	—	4	6
Oat Water,	32	—	—	—	—
Filtered Water,	—	60	—	92	102
Barley Water,	—	—	64	—	—
Cane Sugar,	2.5	—	4	—	—
Milk Sugar,	—	6	—	6 1/2	6
Table Salt,	0.083	—	30 grs.	—	—

Most of the large cities in the United States have Infant Milk Depots and it is the consensus of opinion of those interested in the work, that the results have been exceedingly beneficial. The official report of J. W. Kerr of the Public Health Service, bearing upon Infants Milk Depots established in American cities, is most interesting and his conclusions and recommendations are sound:

“There is great necessity for a wider extension of this movement, in order that its benefits may be felt in every congested center of population in the United States. In many of these areas the unsanitary conditions surrounding the lives of infants are a menace to the State. Diffusion of knowledge with respect to all that pertains to infant hygiene is therefore demanded. Mothers should be encouraged in every possible way to nurse their infants, regardless of financial or social status. When breast feeding is clearly impossible, a pure supply of cow’s milk, modified to meet the special needs of the infant, should be rendered available for both rich and poor. At the same time mothers should be instructed regarding the special requirements necessary to successful artificial feeding, including the

care and administration of milk in the home. Private philanthropy has led the way. The public, through its official representatives, should assume its share of responsibility, both because of economic and sanitary considerations, and provide infants' milk depots for improving the physical well-being of the children who are destined to become the active producing members of the community of the future."

Municipal authorities are ever backward in expending money to safeguard health. Were it not for private philanthropy and courageous business men with vision and initiative, but little would ever have been done in this world in the practical application of the truths revealed to men by scientists and geniuses. As an illustration of the effect on infant mortality due to careful control of the milk supply of a modern city of moderate size, it is interesting to compare the summer death rate of children in the City of Rochester, N. Y., for two nine-year periods, one without milk depots and the other with:

#### INFANT MORTALITY JULY AND AUGUST

	Years 1888-1896 No Depots	Years 1897-1905 With Depots	Percentage of Increased Mortality During period Milk Depots were not in use
Death of infants under one year of age,	1638	761	115.2
Death of children 1 to 5 years of age,	361	241	49.8
Total deaths under 5 years of age,	1999	1002	99.5

The average population of Rochester during the period 1888-1896 was 138,000 and during the next nine-year period, 170,000, an increase of over 23 per cent. Considering the increase in population, mortality statistics show that 1,460 lives of children under 5 years of age were saved in this one city during two summer months of each of the nine years, due to intelligent application of scientific principles in milk preparation for infant feeding.

This same ratio of children's mortality reduction applied to the entire United States, would represent about 100,000 children saved during July and August of each year—a truly astounding figure.

It is now well established that the large majority of infantile deaths is caused by gastro-intestinal diseases. Further, that this great fatality occurs especially among artificially raised infants, and finally the vast majority of cases and deaths from bowel trouble in children occur during the warm summer months. The infant mortality in all countries is outrageously high. That this condition is unnecessary is proven by the fact that infants who are well and scientifically cared for show a relatively low mortality. Defective feeding is the active cause of high infant mortality, while heat, humidity and unsanitary environment are contributory causes. It should be remembered that the normal intestinal mucous membranes are permeable to bacteria, and more so during the period of infancy than of later life. Hence one of the great dangers of using bacteria-laden milk. While the factors involved in this tragic condition are numerous, they depend primarily upon the activity of micro-organisms. Freeman believes that the decline in the infant mortality in the United States during the last

ten years, and especially in New York City, is due for the most part to the decline in mortality from summer diarrhœa, and states "that the general adoption of pasteurized and sterilized milk for infant feeding is by far the most important agency."

Park and Holt, as a result of exhaustive investigation in the tenement districts and institutions of New York, have said: "The number of bacteria which may accumulate before milk becomes noticeably harmful to the average infant in summer, differs with the nature of the bacteria present, the age of the milk and the temperature at which it has been kept. When milk is taken raw, the fewer bacteria present, the better are the results. Of the usual varieties over 1,000,000 bacteria per c. c. are certainly deleterious to the average infant." And yet, through ignorance and stupidity, little children continue to be fed with old dirty milk with a bacterial content ten, twenty and even over one hundred times as great as that which scientific research has proved to be dangerous to infant health and life. In 1905 there were deaths within the United States registration area equivalent to 1.62 per cent. of the population, and of these 19.4 per cent., or approximately one-fifth, were among infants less than one year of age. Diarrhœa and summer complaint caused the death of 37.5 per cent of these children. On this basis to-day of 100,000,000 total inhabitants, this would mean 117,000 deaths per annum of infants under one year of age, due to erroneous summer feeding, and 312,000 total deaths per annum of such babies, a large percentage of which could be attributed to faulty milk supply, unpardonable ignorance and inexcusable hygienic and sanitary conditions. During the years 1892-1897, in Paris and the cities of

France, with populations exceeding 30,000, the deaths from diarrhœa by months per 1,000 total deaths of infants under one year of age were as follows:

January, 212.8	May, 303.1	September, 537.7
February, 211.1	June, 428.4	October, 431.5
March, 224.8	July, 587.1	November, 304.6
April, 254.8	August, 606.4	December, 235.9

In Paris the deaths from this cause averaged 380.3 per 1,000 for six years and in 11 other large French cities the average was 420.5.

It is seen from the above table that, though the months of June, July, August, September and October present the most deplorable proportion of deaths from diarrhœa, this cause is not negligible in autumn and winter.

In Germany, according to Behring, of every 1,000 children born alive 235 succumb during the first year of life. Only 510 out of 1,000 males born attain manhood. Not more than one-third of those reaching maturity, or 17 per cent. of the born males, are found to be physically fit for military service. These sad facts Behring attributes very largely to the ulterior effects of infection derived in infancy from milk.

During the first year of its life, a child consumes about 500 quarts of milk, and if this enormous quantity is obtained from cows, there is a strong possibility that some of it will be unsanitary and much of it unscientifically handled; and there is also the possibility of occasional contamination and infection; therefore, the risk accompanying the artificial feeding of infants and the milk-food supply of older children is palpably great. Newsholme's

*RELATIVE MORTALITY FROM GASTRO INTESTINAL  
DISEASE IN BREAST-FED AND BOTTLE-FED INFANTS*

*LESS THAN ONE YEAR OF AGE IN PARIS BY WEEKS THROUGHOUT AN ENTIRE YEAR*

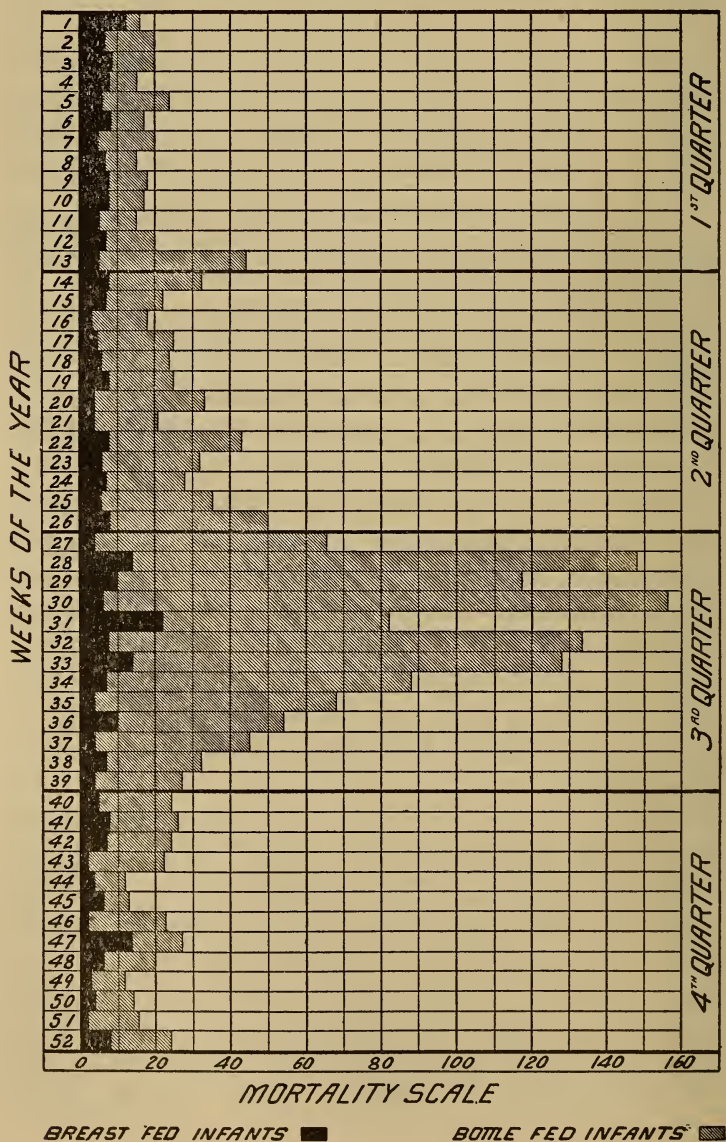


FIG. 19.

investigations indicate that the mortality among breast-fed babies is only one-tenth that of artificially fed infants. Tyson states that of all infants who die in England in the first year of life, 75 per cent. have been fed with cow's milk or other artificial foods. Sandilands found that in Brighton, England, only 16 per cent. of children dying of intestinal troubles, under 9 months old, were breast-fed. In 1898 statistics show that the number of deaths of artificially fed infants in Paris was double that of breast-fed babies at all times during the year and in August, the mortality was in the ratio of 8 to 1. Turner has stated that during the summer months at Brisbane, Australia, more than one-half of the bottle-fed babies die.

There is some excuse for working women putting their children on the bottle early in life in order that they may again go to work, if such work away from the home is necessary for the support of their families; but there is no excuse for women who do not have to work for a living and who do or should take charge of their household and who are physically capable of suckling their offspring, neglecting, because of so-called social demands and a life of ease, to give their progeny the food that nature ordained they should have to nurture and develop them. There is a regrettable high infant mortality rate in the manufacturing towns where married women work in factories. Reid found that in five cities where 12 per cent. or over of the married women were factory workers, the infantile mortality was 198 per 1,000; in thirteen cities where this percentage of employed mothers was between 6 to 12, the mortality rate of children was 156, and in 8 cities where the percentage of working mothers was under

6, the infantile mortality was 149. The same general results were shown by Harrington in an investigation of the mill towns of New England.

If a woman leads an ordinary life and receives intelligent care during the period of parturition and confinement, there is no reason why, in the vast majority of cases, she cannot suckle her young offspring. The so-called nervous temperament of the average society woman is no excuse for depriving a child of its legitimate right and the normal functioning of the lactic organs of a woman make for health and natural living. Some poor women are driven for economic reasons to sacrifice the health of their children and their own health, but there is no excuse for women in moderate or comfortable circumstances, or for those living in luxury, handicapping their children in order to give themselves more freedom of action and thus deliberately sidestep what is to them but a disagreeable maternal responsibility which they are anxious to avoid.

Madame Dluski, in a thesis delivered at the Baudelocque Clinic, Paris, expresses the opinion that among 100 healthy women, when the necessary conditions of alimentation and repose are present, 99 are actually able to nurse their offspring. She concludes that women, almost without exception, can nurse their babes; that four-fifths of mothers can do so from the beginning of lactation; that nearly all can do so after a longer or shorter time, and that absolute agalactia does not exist. Yet, despite all efforts to promote the practice of breast-feeding, a great proportion of infants are bottle fed. Indeed the practice of feeding infants with the milk of animals (goats and cows) is of great antiquity—the Greeks and Scythians had re-

course to it—but the pernicious practice is known to have greatly increased in modern times.

Von Bunge's statistics, gathered from all parts of Europe, indicated that 75 per cent. of women could nurse their children if they would. Budin tells us that 448 out of 557 women who attended a Parisian hospital were able to nurse their children. In France and Italy rooms are set apart in factories where working women can nurse their babies at certain hours, and in Italy the law compels each industrial establishment employing 50 or more women to furnish suitable rooms for this purpose.

Rosenau has said:

“Prepare cow's milk as we may, we can not shut our eyes to the fact that it is out of the question to anticipate such good results from artificial feeding as from breast feeding. It is well known that the lowest death rate for the first year of life is shown among those infants who are fed on good human breast milk.

“It is the milk of other animals, usually the cow, which directly or indirectly kills the greatest number of infants. All are agreed that if a child must be artificially fed it is best to use fresh, pure milk; but when we consider that thousands of infants in our large cities must depend upon the milk of a cow many miles away, we are confronted with a difficulty not readily overcome. Nature did not intend the young of one species to be raised upon the milk of another, much less did it intend that milk to be dirty, stale, and bacteria-laden. We have unanimous testimony that such milk, especially in the heated months of summer, is the cause directly or indirectly of the excessive infant morbidity and mortality.

"The average city market milk that has already deteriorated in quality can not be revived. No known process will make bad milk good milk; but further fermentation and putrefaction in the milk can be stopped, and pathogenic organisms killed, by heating it to 60 degrees C. for twenty minutes. Bad milk, whether heated or unheated, is unfit for infant feeding, but if infants must depend upon old dirty and uncared for milk it would be much better, especially in the summer months, to practice pasteurization, in spite of its alleged disadvantages.

"The quantity of certified or clean milk in any community is but a drop in the bucket, and until health officers can assure a good quality of milk the only protection we have is the expedient of heating it.

"It is by no means claimed that heated milk is the ideal to be attained. On the contrary, we want good, fresh milk that needs no heating. At present it is exceedingly difficult to obtain such milk in our large cities, and anyone who investigates the matter carefully will soon convince himself that it will be many years before this is possible and only after a revolution of the milk industry. In the meantime we must protect ourselves."

This protection will be best obtained by teaching healthy mothers, physically capable of nursing their children, to do their natural duty for the good of the helpless little ones, and to demand of the state or city that milk be produced and sold under scientific inspection when fresh, wholesome and comparatively low in bacterial count, free from pathogenic germs and the product only of cows tested by licensed veterinarians and found to be free from tuberculosis and other forms of disease.

A child is of value to the world, to the state and to the community as well as to the parents; if the mother will not willingly nourish by natural means the child which she has brought into the world, and if she is capable physically of doing so and her status economically permits it, it might be well for the state to compel her to perform her maternal duty just as it compels a father and husband to support his family. This would not be socialism, but rather the outworking of justice and spiritual or altruistic individualism. If the modern mother considered her sons her jewels, as did Cornelia, the mother of Gracchi (second century B. C.), the performance of a natural duty would not selfishly be considered a sacrifice, but rather a heaven-given pleasure of maternal service. One of the curses of our artificial civilization is the disinclination of mothers to feed their little ones at the breast because of the exacting trouble maternal nursing involves and the divorce it necessarily entails from social pleasures and spurious pursuits.

Every mother should nurse her child unless there are cogent reasons to the contrary. The following causes may be mentioned as contraindicating maternal nursing:

(1) Tuberculosis, latent or active, affecting the mother. By nursing the child she can but accelerate the progress of the disease, besides possibly exposing the child to the danger of contracting it.

(2) When the mother is affected by grave, chronic, or systemic disease.

(3) When the mother is choreic or epileptic.

(4) If she has suffered from any severe complication of the parturient state, such as hemorrhage,

eclampsia, nephritis, puerperal septicaemia, and the like.

(5) Local disease of the mammary gland.

(6) When as the result of two previous experiences under favorable conditions she has shown her inability to properly nurse her child.

(7) When no milk is secreted.

Cow's milk is not a natural food for children. It is essentially an alien food and its composition, even if it could be obtained in a sterile condition, is not adapted to a human being, but the nourishment of an animal on a different zoological plane. When an infant is deprived by force of circumstances of its legitimate natural food, then the greatest possible care should be taken in the choice of substitutes. Science must be appealed to and immutable universal truths must supplant the ignorance and indifference of the past. The average general practitioner knows little, if any more, about the correct feeding of adults, not to mention children or infants, than did the soothsayer of old or the medicine man of the aborigines. Parents must learn the basic truths affecting their well-being and the lives and health of their progeny, study the research work and benefit by the work of the real scientific wrestlers with cosmic truth. Then armed with the facts compiled and organized for man's use by the world's leaders, such as chemists, analysts, bacteriologists, etc., they should go boldly forth doing what their innate intelligence tells them to be right and sound in principle, scorning to have their minds fettered to superstition and the conventional inertia of an irrational fanaticism void of logic and reason.

### **Carbonated Milk**

In an attempt to preserve milk and furnish an appealing drink which will be marketable and somewhat resemble Koumiss, it is reported that milk will be exploited in the near future as an effervescent or carbonated bottled drink. It is claimed that such a treatment of milk will retard the growth of bacteria and will be no more injurious to health than any charged water or the carbonic acid water of soda fountains. Milk which is carbonated under a pressure of seventy pounds to the square inch comes from the bottle we are told, as a foamy mass quite similar in taste to Koumiss that is two or three days old. It has a slightly acid, pleasant flavor due to the carbonic acid and a somewhat more salty taste than ordinary milk. The cream separates as usual in the bottle, but by slight shaking is redistributed throughout the milk so that, as it is poured from the bottle, it is smooth and satisfactory.

The advocates of Carbonated Milk maintain that pasteurized milk so treated will possess high food value, palatability and stability. Such a milk may appeal for a time and run its course as "something new and different" and thus take its place with new foods and drinks which are constantly being brought out to tempt and satisfy our far too sensitive palates. Carbonated Milk will not prove of much importance in the solution of our milk problem.

### **Peptonized Milk**

Peptonized Milk is a specially prepared product for the use of infants and invalids. The protein constituents of milk, when treated with pepsin under suitable conditions, become somewhat pre-

digested, and are, therefore, more easily assimilated when taken into the system. Less labor is required of the digestive tract and nutrition is increased.

### **Milk Preservatives**

The only legitimate preserving agents in relation to milk are (1) initial and maintained cleanliness with its accompanying purity and low bacterial content of the commodity, (2) sterilization, which is commercially impracticable and can therefore be ignored, (3) cold; the speed of growth of micro-organisms falls almost to zero at the freezing point of water, but rises at a prodigious rate at a summer heat, hence to preserve milk as long as possible, it should be kept constantly at a very low temperature by ice or mechanical refrigeration.

As milk will not keep sweet, especially in the summer, for long periods of time, and as the great consuming demand is for fresh milk and not soured milk, unscrupulous dealers have attempted to preserve their milk by the addition of chemical antiseptics, germicides or preservatives, which are supplied to the trade under the general name of Milk Preservatives. The effect of these substances is to hinder the growth of the bacteria which the milk may contain, retard the lactic acid fermentation and thereby retard the souring of the milk. Various chemical agents have been used as preservatives. Obviously the most effective disinfectants, such as corrosive sublimate, carbolic acid, etc., cannot be used on account of their poisonous nature, but formaldehyde, sodium bicarbonate, salicylic acid, benzoic acid, boracic acid, hydrogen peroxide, borax, quicklime, common salt, certain fluorides, potassium dichromate, etc., have been used more or less ex-

tensively. Chemical solutions of formaldehyde are sold under the name of **FORMALIN** (40 per cent. strength), and when still more diluted have been supplied the dairymen under such trade names as **Freezine**, **Iceline**, etc., and boric acid solutions have been sold under the name of **Aseptine**.

The use of any form of chemical or foreign preservatives in milk should be unhesitatingly and scathingly condemned. Perfectly harmless preservatives have not been discovered, and, notwithstanding the claims of irresponsible dairymen, biased investigators and chemical manufacturers, never will be. Whatever ingredients are necessary for the proper nourishment, healthful balance and keeping properties of milk, have been placed there by nature, and man's role is to play the game by strict conformity to nature's laws of sanitation and hygiene, and not seek for artificial means to violate nature's laws and then avoid, through the science of chemistry, the retrogressive thrust of the boomerang. The use of preservatives in milk is illegal; the practice is condemned by all recognized authorities, and yet preservatives are used surreptitiously more than is generally believed.

The American Association of Medical Milk Commissioners, in their *Methods and Standards*, adopted in May, 1912, say that "All certified milks and creams shall be free from adulteration and coloring matter, and preservatives shall not be added thereto." And again: "Tests for the detection of formaldehyde, borax and boracic acid shall be applied at least once a month. Occasionally application of tests for the detection of salicylic acid, benzoic acid and the benzoates are also recommended."

It is believed that the art of chemical preservation of commodities such as milk has advanced and become so protectingly involved that it is difficult for the ordinary chemist, unless a student and specialist, to detect them in samples submitted for his examination and report. Politically-appointed chemists in city, state and federal laboratories may be unusually competent, or may be most incompetent, to make practical, thorough tests for the detection of impurities in milk, but it is known that such laboratories have passed as good milk, free from preservatives, milk that has a subtle preservative therein that cannot be soured in the summertime with the lactic acid Bulgarian bacillus, and that keeps sweet outdoors in hot, oppressive weather for unusually long periods of time. Certified milk has occasionally in the past caused epidemics of disease, and certified milk with preservatives added in violation of the requirements of the milk associations, though fortunately uncommon, is not unknown. If such high class milks of boasted purity and generally conscientious production are at times chemically treated and foisted upon the public with malicious deception, what can the average city dweller expect of ordinary market milk, brought probably hundreds of miles from the farm to his door and delivered during the heat of the summer, as sweet, fresh milk even when two days old or more. The pasteurization of milk for use in cities is probably the best preventive measure in regard to the use of chemical preservatives in milk. If milk is required by law to be pasteurized, and if the health authorities have an organization of competent inspectors to enforce such a statute, unscrupulous dairymen will not be tempted to doctor

their product so that it will keep sweet for long periods of time. Wiley says that there is but little adulteration of milk with chemical preservatives in the United States today, and the activity of Federal inspectors under the law of June, 1906, found many flagrant cases of adulteration and misbranding, but only a small percentage of the milk samples tested by the various laboratories of the Bureau of Chemistry showed the use of detectable preservatives.

Formaldehyde in some form or other has been popular as a milk preservative. Trillat says that formaldehyde renders the casein of milk more or less indigestible, and a further objection to its use is that part of it remains unaltered in the various foodstuffs with which it is admixed, and, being absorbed as such by the system, may act injuriously on the digestion. Pottevin has observed that formaldehyde retards the coagulation of milk by rennin, and Bliss and Novy, confirming the conclusions of Trillat and Pottevin, have found that under the influence of formaldehyde the caseinogen of milk is rapidly altered in such a way that either the rennin coagulation takes place only very slowly or not at all. Thus if formaldehyde in the proportion of 1:500 be allowed to act on milk for a few hours, the milk is not coagulated on the addition of rennin. On the other hand, they observed that the rennin itself is not readily destroyed by formaldehyde, so that the delay or hindrance of the rennin coagulation of milk by formaldehyde is evidently due in some way to an alteration in the composition or properties of the caseinogen. Similar experiments on the action of formaldehyde on the digestive ferments have been made by Halliburton. He observed that .5 per cent. of formaldehyde renders

gastric digestion almost impossible and .05 per cent. delays it considerably. With .1 per cent. formaldehyde, no pancreatic digestion of fibrin occurs in 24 hours, and dilute solutions of the aldehyde delay the pancreatic digestion of starch. He also confirms the deleterious effects exerted by formaldehyde on the rennin coagulation of milk. Rideal and Foulerton say that the small quantity of formaldehyde or boric acid required to preserve milk for 24 hours, has no appreciable effect on the digestibility of milk and interferes less with the pancreatic digestion of casein than tea, claret or Worcestershire sauce. To say that certain substances are harmless because they are believed to be somewhat less harmful than other substances known to be deleterious to health is not scientific, and the writer can testify to the positive harmfulness of formaldehyde as a food and milk preservative.

Forster, after thoroughly investigating boric acid as a food preservative, concludes that the continuous administration of small amounts of it affects the health of the individual, and "its use as a milk preservative, especially in milk to be used by children, should be condemned." Welch has reported some alarming instances of poisoning following the local application of large amounts of boracic acid, and Chittenden says that borax in quantities retards the proteolytic activity of digestive fluids. Gies found that boric acid and borax in large amounts produced nausea, and Neumann even recommended the use of boric acid as a milk preservative because only large amounts can cause death by gastroenteritis or by its deleterious effect upon the nervous or muscular system—a truly astounding reason for its advocacy. Liebreich admits that since the introduc-

tion of borax into the field of medicine, two hundred years ago, there have been many deaths from boric acid poisoning, yet he advocates the use of boric acid and borax as food preservatives, maintaining that the critical spirit of the day is a matter of regret. He inquires somewhat petulantly, "Who would have made the introduction of pickled meat, smoked beef and such like dependent on a chemical and pharmacological investigation?" This mental attitude takes Liebreich out of the scientists' class and makes of him a prejudicial investigator, seeking to bolster up one side of a case—an attitude of mind most unfortunately often assumed by investigators whose work is in the interest of commercial patrons. The outrageous "embalmed meat" experiences of the Spanish-American War—a heinous national disgrace—suggests, notwithstanding Liebreich's peevish ridicule, the propriety of even meats being subjected to "chemical and pharmacological investigation."

Salicylic acid and benzoic acid are, fortunately, seldom used as milk preservatives, for both of these substances are toxic, and the former, according to Kastle and Roberts, is more or less cumulative in its effects upon the system. The injurious effects resulting from continuous small daily doses of salicylic acid were first pointed out by Brouardel, who made a plea for its discontinuance as a food preservative and for more thorough and systematic examinations of preserved foodstuffs by chemists and health officers.

The use of hydrogen peroxide has been urged in recent years as a preservative in milk. Budde employed a 3 per cent. solution to sterilize milk at somewhat lower temperatures than those employed

In pasteurization and claimed that after the peroxide ( $\text{H}_2\text{O}_2$ ) was in the milk for a time, one atom of oxygen (O) passed off, leaving the substance as plain water ( $\text{H}_2\text{O}$ ), and in the meanwhile it had destroyed most of the bacteria. Lakin objects to Budde's process of sterilizing milk on the ground that it still contains small amounts of the unchanged hydrogen peroxide, and also in consequence of the injurious impurities commercial solutions of hydrogen peroxide are liable to contain—such as boric acid and arsenic—which are present in the substances from which the solution of hydrogen peroxide are made. Gordan states that the small amounts of hydrogen peroxide employed by Budde in his process of sterilizing milk have practically no sterilizing action, and that if employed in quantities sufficient to sterilize, it imparts a taste to the milk and renders it unfit for human consumption. The method, whether effective or not, is fortunately too expensive for general use, and it has not been practiced commercially either abroad or in our own country.

The use of oxygen for disinfection has also been recommended. This gas is, of course, perfectly harmless, and, moreover, it rapidly passes off from the milk so that it could not be classed as a preservative adulterant. No practical commercial method of using it to purify a milk supply has, however, as yet been devised.

Fluorides are irritating poisons of considerable power. Rubuteau found that one-quarter of a gram of sodium fluoride, injected subcutaneously, proved fatal to rabbits, and Kolipinski, Schulz, Heidenhain and Weinland have all reported on the toxic power of fluorides. Czrellitzer states that such sub-

stances are an active poison for all forms of cells and for protoplasms generally. Insecticides containing sodium fluoride taken by accident internally have caused violent poisoning. Baldwin, experimenting upon himself, found that one-fourth gram produced nausea in two minutes and reached its maximum poisoning effect in 20 minutes, subsiding in about two hours, but nausea continued after eating and at intervals throughout the day. In his testimony before the food preservatives committee (London) Halliburton took the stand that the use of food preservatives should be abandoned and methods of cold storage and transportation substituted in their place, upon the ground (1) that an antiseptic which is inimical to the life of those organisms that cause putrefaction cannot be harmless to the vital processes of the higher animals; (2) numerous clinical observations have been recorded which show that dyspeptic and other troubles follow the use of foods which have been treated with preservatives ordinarily employed for such purposes, such as borax; (3) even if as in the case of boric acid and borax, the poison is not cumulative, the continuous passage of foreign substances through the kidneys can not be beneficial to those organs. A similar stand against the use of preservatives in food has been taken by Leffmann. According to this author, the bad effects of a food preservative may show itself in several ways: (1) It may interfere with the action of the digestive ferments, as has been proven in the case of salicylic acid; (2) it may act on the food, like formaldehyde, and (3) it may work a direct injury to the body, as is known to be the case with almost all mineral preservatives. Hope looks upon it as proven beyond dispute that

chemical preservatives, while checking the putrefactive changes in food, also check the fermentative processes of digestion. Especially does he regard the use of preservatives in milk as absolutely indefensible, and points out that the experiments of the bacteriological department of the Thompson-Yates laboratories are sufficient in themselves to establish the dangers of this practice, even if they stood alone. According to this author, there are numerous cases of injury resulting from the use of milk so preserved. He is therefore of the opinion that cleanliness and cold alone should be relied upon to insure the preservation of milk. Vaughan and Veenboer have arrived at the conclusion that it is desirable to prevent the use of formaldehyde in any and all foods, and also not to allow the use of *any* preservatives in milk. The English commission appointed to inquire into the subject of food preservatives, upon the testimony and findings of seventy-eight experts, prohibited the use of all preservatives and coloring matters in milk, and at the International Congress of Hygiene, held at Brussels in 1903, resolutions were passed practically prohibiting the use of preservatives in all kinds of food.

Some investigators have contended that in view of the exceedingly perishable nature of milk and the fact that it frequently has to be brought long distances before reaching the consumer, the use of a preservative is not only legitimate, but distinctly advantageous from a hygienic standpoint, providing that the preservative is not injurious to the health of the consumer.

Kastle and Roberts of the United States Public Health Service, after exhaustive and commendable research work and a thorough consideration of this

entire subject, say "that the preponderance of medical and scientific opinion is decidedly against the use of preservatives in milk, not only on account of possible injuries, especially to young children, resulting from the continued use of such preservatives in small amounts, but also for the reason that the use of such substances, if permitted, would ultimately tend to carelessness and uncleanness in the handling of milk. Cleanliness and cold, the rigorous enforcement of the tuberculin test, and proper medical supervision of the dairies and those who handle the milk are the prime essentials for a pure milk supply, and no method of sterilization or preservation is likely to give good results."

Richmond has pointed out that in hot summer weather, milk preservatives are comparatively useless unless added in relatively large quantities. He also calls attention to the fact that when once the souring of milk containing a small amount of preservative begins, it proceeds at an increased rate as compared with milk to which no preservative has been added.

Wiley has said: "Practically all nations have by legislation or judicial decision prohibited the use of preservatives in milk, though some permit the presence of boron in other substances. In this country the presence of borax and formaldehyde is forbidden in milk, but benzoate of soda may be used in any quantity desired by the manufacturers provided its presence and the amounts employed be stated on the label. Fortunately, benzoate of soda is an extremely poor preservative for milk, and, in so far as I know, very little use has been made by milk producers and dealers of the permission granted to use this chemical. Whatever may be

true of the ability of adults to tolerate a certain amount of chemicals in their food, it must be admitted that the infant is not thus constituted. No matter what the chemical may be (and benzoate of soda is no better than many of the condemned chemical preservatives), there are few who have the temerity to urge either the unrestricted or even the restricted use of chemical preservatives in milk."

Chemical preservatives of every kind are unnecessary and should be forbidden by drastic measures, aggressively enforced, for no chemical substance has been discovered nor will be found which possesses active bactericidal properties without, in any way, affecting either the food substances to which it is added or the human subject who consumes it.

### **Adulteration of Milk**

There is no food more easily adulterated than milk. Water, coloring materials and a variety of disinfectants or preservatives can be put in it without the consumer being aware of it or even having any suspicion that fraud is being perpetrated upon him and possibly the health of his household menaced. It is time that we thoroughly recognize the close association between the purity of the milk supply and the public health and adopt protective measures for the home with a practical working system of supervision and inspection; the individual is absolutely incapable of protecting himself and must depend upon an honest, capable and efficient official system for the safeguarding of his health and that of his family and household, and also his protection from fraud and the insidious artifices of unscrupulous dealers.

The adulterations of milk consist of

1. The removal of cream—skimming.
2. The addition of skim milk.
3. The addition of water—watering.
4. The addition of thickening agents.
5. The addition of coloring matter.
6. The addition of substances to alter the taste or the odor of milk.
7. The addition of substances to increase the “total solids” content of milk.
8. The use of preservatives or disinfectants

The commonest forms of adulterations are skimming, watering and the addition of artificial coloring matter and preservatives. The use of thickening agents, such as chalk, starch, calves' brains or glycerine have almost passed out of vogue among farmers and dairymen. Water is added to milk to increase the output of the dairy; the skimming or watering of milk, or the addition of skim milk to natural whole milk, all tend to affect not only the physical properties and chemical composition of the milk, but also its appearance, hence the necessity of resorting to artificial coloring substances to conceal what would otherwise be recognized as a palpable fraud. Thus one form of adulteration leads to another. The addition of water to milk should be considered not only a fraudulent practice, but a criminal one. If the mere rinsing of milk pails in polluted water results in epidemics of typhoid—and many hundreds of serious epidemics have been caused in this manner—how much more serious is it to deliberately put quantities of contaminated water into a food liquid which is peculiarly adapted for the prolific reproduction of the micro-organisms of disease?

Water itself is not a good food medium for pathogenic germs and much water may carry but a relatively small quantity of typhoid bacilli, but such bacteria placed in milk, through water as a carrier, find themselves in the best possible culture medium for growth and multiplication. The majority of farms are relatively low in sanitary efficiency in respect to water supply, as it is affected by sewage, cesspools, etc., and water mildly contaminated for direct drinking purposes may cause milk to be virulently noxious without the suspicion that water is the direct cause of the contamination of the milk.

To detect watered milk in a laboratory, aside from specific gravity, refractometer readings, determination of freezing point and chemical composition as compared with standards, advantage is also taken of the fact that practically all natural water contains certain substances such as nitrates and nitrites not ordinarily present in milk; if these substances are found in a sample of milk it is most probable that water has been added to it. According to Comanducci, the watering and skimming of milk may be determined by the lowering of what he proposes to call the index of oxidation of milk. This he determines by means of tenth-normal potassium permanganate in acid solution. The number of cubic centimeters of potassium permanganate solution required to oxidize one cubic centimeter of milk is what this author calls the index of oxidation. This has been found to be different for the milk of different animals, but practically constant for the normal milk of any particular species. He gives the following values for the index of oxidation of the milk of various animals: Cow, 50-52; goat, 44-46; ass, 55-58; sheep, 43-48; woman, 53-60. He also

finds that the value of the index of oxidation of cow's milk diminishes with the amount of water added, and also with skimming. Thus the index of oxidation of cow's milk, containing 50 per cent. of added water, was found to be 25 and that of skimmed milk 40 to 42 instead of 51—normal. Kastle and Roberts, in their admirable United States Government Report on the Chemistry of Milk, have said that milk is sometimes adulterated by the addition of certain substances, such as sodium carbonate and bicarbonate, cane sugar and saccharine, intended to alter or disguise the taste of milk. Sodium carbonate and bicarbonate are sometimes added to sour milk with the view of neutralizing the lactic acid and preventing or delaying the separation of the curd. Cane sugar is added in order to increase the amount of total solids in milk impoverished by watering, and also to increase the sweet taste and thereby disguise any slightly sour taste which old milk may possess. Saccharine is sometimes added to milk for the same purpose. It not only increases the sweet taste of milk, but probably also acts as a mild antiseptic. While all of these substances are probably harmless in the amounts in which they are employed in milk (certainly the addition of cane sugar can ordinarily do no particular harm), the practice of adding these substances to milk is to be condemned, mainly on the ground that they are rarely used except to conceal deficiencies in the quality of the milk itself, thereby enabling the dairyman to palm off on the consumer milk which ordinarily would not be found acceptable.

Artificial coloring matter is used in milk to conceal other forms of adulteration, such as skimming

and watering, and to make the milk appear richer than it really is. Among the coloring matters which have been employed for this purpose are annatto, certain of the yellow and orange-colored azo dyes (coal tar dyes), caramel, etc. Generally speaking, the adulteration of milk with these artificial coloring matters is in itself not of very great importance, inasmuch as they are used in very small quantities. The fact, however, that they are employed mainly with a view of concealing other more dangerous adulterations, such as the addition of water to the milk, puts the use of artificial coloring matters in milk in the class of dangerous adulterations. Houghton has found that annatto, which can be detected by an ether test, diminishes the digestibility of protein, and other investigators have proved that many of the coal tar dyestuffs, when not actively poisonous, interfere with the action of digestive ferments and all are apt to be contaminated with powerful poisonous impurities.

Kastle and Roberts have reported an interesting case of milk adulteration that came under their observation at the Government Laboratories. A sample of milk supplied the guests at a prominent hotel was submitted for test. It was found to contain formaldehyde as a preservative and to be artificially colored with an azo dye. The specific gravity was 1.0213; fat content only 1.7 per cent., or one-half of what it should be; ash, .43 per cent., and total solids only 7.5 per cent. The milk was watered and contained a very large number of bacteria. It had been produced under unsanitary conditions, was old and dangerous, of little food value, and yet such milk, a positive menace to health, chemically treated to keep from going sour and doctored with

artificial colored matter to look rich and creamy after it had been thinned with water, was inflicted upon the unsuspecting guests of a first-class hotel, who paid a high price for the best and were imposed upon outrageously. Dr. Wiley's report on the National Inspection of Milk indicates that adulteration of milk is still quite common and "a large percentage of the milk going into some of our great cities is either watered or skimmed, or both."

### **Soured Milks**

As far back in antiquity as we can probe, chiseled and written records, legends, traditions and findings in geological strata—the unerring histories of ages—all unite in suggesting that the milk industry is one of the oldest known to mankind. In the Paleolithic and Neolithic Ages, the Nomadic races possessed cattle and used their milk as food, and, according to the Vedas, the manufacture of butter was known in India 1500 B. C.

From time immemorial the milk of various animals has been used in Eastern Europe and Asia Minor as an important item of food, and most of this milk has been used when sour, for keeping milk "sweet" under conditions existing was a difficult and practically an impossible task. From ancient times to the present, milk from camels, goats, buffaloes and sheep has been used indiscriminately throughout the East. There are many Bedouin tribes who would scorn to own cows or oxen, for the "Sons of the Desert" and many Nomadic peoples look upon the cow as a degraded animal and fit only to be the property of races who have lost their independence and become serfs of the land and barterers of its product. The Bedouin considers the cultiva-

tors of land and the builders of towns as debased, perverted branches of the human family; they have only contempt and derision for the artificialness of our civilization, hence their disdain for the domesticated cow, which they consider a degenerate in the animal world. We are told that among the Bedouins and Jebours it is considered derogatory to the character of a man to milk a cow, or even a sheep, but a man can milk a camel and maintain his self-respect. Layard writes that the milk of the sheep and goats of Bedouins "is shaken into butter or turned into curds; it is rarely or never drunk fresh, new milk being thought very unwholesome in the desert. The curds are formed by boiling the milk and then putting some curds made on the previous day into it and allowing it to stand. When the animals no longer give milk, some curds are dried to be used as leaven on a future occasion. This preparation, called 'leben,' is thick and acid, but very agreeable and grateful to the taste in a hot climate. The sour milk, a universal beverage among the Arabs, is either buttermilk pure and undiluted or curds mixed with water." The wandering tribes of Africa and the East consider the milk of their flocks and camels more wholesome when it has been slightly fermented or soured by being poured into a milk skin, on the inside of which are sour clots from the previous milkings; in a warm climate such milk quickly becomes slightly sour throughout when agitated.

Many descriptive writers of life in Palestine, Egypt, Arabia, Persia, Turkey and the Balkan States tell us that various forms of soured milk are in universal use today as in the past, and Taylor, in the "Lands of the Saracens," speaks of the use of "thick buttermilk, not remarkably clean, but very

refreshing." [Metchnikoff says that the chief food of the natives of tropical Africa consists of soured milk, and in Western Africa, in the region south of Angola, the natives live almost entirely on this product, there being a difference in the curdled milks produced, according to the nature of the microbial flora which is introduced. Acerbi tells us that reindeer's milk constitutes a principal part of the Laplander's food, and in the far north most of the milk is soured and frozen. This is an interesting fact, for, with this one exception, it seems that only the people of the East, the tropics and the Nomads of the Desert have appreciated in the past the virtue of soured milk, and they were probably originally driven to consider its use by the difficulty of keeping milk sweet.]

[Bulgaria has been popularly termed of late "the land of long life." It is stated that the majority of the natives live to an age considerably in excess of what is recognized as "a good old age" among Western nations. Douglas says that inquiry has shown that in the eastern part of Southern Europe, with a population of about 3,000,000, "there were more than 3,000 centenarians found performing duties that would be assigned to a man of 65 years of age elsewhere." Reinhardt has said that it is quite common to find among the peasants, who live to a large extent upon soured milk, individuals of 110 and 120 years of age. Metchnikoff has said that in Servia, Bulgaria and Roumania there were 5,000 centenarians living in 1896, and while many reasons are advanced for such an abnormal condition of affairs, it seems fairly certain that the sole reason why people in these districts live to such great ages is because of their mode of living and the

fact that they subsist largely on soured milk. H. C. Venables, British Vice Consul at Varna for many years, says that soured milk is known by the peasants as "yogourt," a word spelt differently according to the locality in which it is used. The best yogourt is prepared from sheep's milk, the second quality from buffaloes' milk and the poorest from cows' milk. The culture is known as "Bulgarian Maya," and the milk which is to be converted into yogourt is first freed of all bacteria by heating or boiling and then allowed to cool to the temperature of about 110 degrees to 115 degrees F.; it is then inoculated with maya and maintained at an even temperature of about 110 degrees F. for several hours.] There are many varieties of soured or fermented milks and they are known by various names. In the eastern preparations lactic fermentation is produced, generally followed by alcoholic fermentation, "which is due to the slow decomposition of the milk sugar, the vinous fermentation being most readily set up in milks which contain a larger relative proportion of milk sugar and water, such as the milk derived from the mare, the sheep and the camel."

The bacteriology of milk is a most profound and complex study. The dairyman is interested in the propagation of lactic acid-producing bacteria, for the quality and the economic production of butter and cheese depends upon it; scientific dietitians seek to eliminate from milk all bacteria which are deleterious to health and at times advocate the inoculation of milk with certain bacilli whose action is proven to be beneficial to man's physical well-being and also conducive to longevity; the various degrees of lactic, alcoholic and gaseous fermentations in milks caused by bacteria, yeasts and molds

are responsible for peculiar sour milk beverages popular in the East, and combinations of the different classes of organisms producing these changes in milk produce a multiplicity of possible results.

Of the soured milks used in the East, the most common are keffir, koumiss, leben, matzoon, dadhi and yogourt, all of which owe their special characteristics to the fact that they have undergone peculiar lactic and alcoholic fermentation, the extent of the latter being comparatively great in some and relatively small in others.

### **Keffir**

[Keffir is an acid, slightly alcoholic, drink, which seems to have been used from antiquity by the Nomadic tribes in the Caucasus. It is made from the milk of the goat, sheep or cow, the characteristic fermentation being induced by keffir grains whose origin is surrounded by myth. The Mohammedan tribes of the Caucasus affirm that keffir grains were presented by Allah to their favored forefathers as a sign of immortality. Freshfield, in "The Exploration of the Caucasus," says that if a man cannot reconcile himself to sour milk he is not fit for the Caucasus. He described keffir as a delicacy—an effervescing milk—obtained by putting into fresh milk some yellow grains, parts of a growth which contains a bacillus which decomposes the sugar in the milk and produces lactic acid, carbonic acid and alcohol. "The grains multiply indefinitely in the milk; when dried they can be preserved and kept for future use."] Sohn says that keffir has been employed with good results for infant feeding, its specific advantage lying in the semi-digested con-

dition of the protein contained in it and no clotting can occur in the stomach.

Prof. Hayem has stated that the good effects of keffir are due to the presence of alcoholic acid, which replaces the acid of the stomach and has an antiseptic effect, and the experiments of Rovigh have confirmed Hayem's theories. Metchnikoff says that with keffir it is the lactic and not the alcoholic fermentation which is responsible for its valuable healthful properties. "The action of keffir in preventing intestinal putrefaction depends on the lactic acid bacillus which it contains," and again, "it is correct to replace it by sour milk that contains no alcohol or merely the smallest traces of it (such as Bulgarian sour milk). The fact that so many races make sour milk and use it copiously is an excellent testimony of its usefulness. Douglas tells us that well fermented, 48-hour-old keffir is an effervescent beverage with prickling and acid taste and a consistency and smell similar to sour cream. According to Hammerstein, normal keffir contains

Water,	88.26	per cent.
Fat,	3.35	" "
Casein,	2.98	" "
Milk Sugar,	2.78	" "
Lactic Acid,	0.81	" "
Ash,	0.79	" "
Alcohol,	0.70	" "
Lactalbumen,	0.28	" "
Peptones,	0.05	" "

The acid is seldom higher than 1 per cent. or the alcohol more than .75 per cent. According to Kuntze, keffir fermentation is the result of the action of various organisms. During the initial stage, butyric acid fermentation takes place, but is pre-

vented from becoming predominant by the action of keffir yeast. Simultaneously a true lactic acid fermentation proceeds and eventually gives place to a subsequent secondary production of butyric acid.

### Koumiss

[It is generally admitted that the greatest of all the fermented milks is koumiss, famous from antiquity as being the principal food of the wandering tribes of Khirgiz, Bashkirs, Kalmucks and Tartars who inhabit the steppes of European Russia and the plains of South, Western and Central Asia. Long before the Christian Era the Scythians made koumiss by the fermentation of mare's milk, and many records are available to show that the Nomads of the steppes, living in the saddle, used the milk of their mares in a fermented state as a substantial article of food. De Rubruquis, a French missionary to Tartary in the thirteenth century, described koumiss in his writings and states that "he found it savoury to the palate." Rubruck, in 1253, records the use among the Tartars of a fermented drink—kosmos—prepared from mare's milk, and about the same time Marco Polo referred to the milk-wine, or chumis, of the rovers of the steppes. Dr. Grieve, in 1784, advocated the use of koumiss for wasting diseases, and later sanatoria for the treatment of pulmonary consumption were established, it is said, with much success in various places in Russia, where they exist to this day.]

Koumiss is another product of the combined action of lactic acid and alcohol-producing organisms. It is made principally from mare's milk, but at times the milk of camels is used, and in some countries even cow's milk has been used as a poor

but easily obtainable substitute for mare's milk. Douglas says that the changes which koumiss undergoes during fermentation "consist in a vigorous gas and acid production, accompanied by alcohol formation and coagulation of the milk. The coagulum exists in an extremely fine state of division and the liquid froths violently when the bottle is opened. It has a full pleasant acid taste, but should not contain more than 1 per cent. acid and 2 per cent. alcohol. The specific gravity of koumiss is 1.008 to 1.020 at 60 degrees F." The following is an analysis of two different samples of koumiss, attributed to Fleischmann:

	KOUMISS	
	From Mare's Milk	From Separated Cow's Milk
	Per cent.	Per cent.
Water,	91.535	88.933
Fat,	1.274	0.854
Nitrogenous bodies,	1.913	2.025
Sugar,	1.253	3.108
Ash,	0.293	0.444
Carbon Dioxide,	0.876	1.027
Alcohol,	1.850	2.647
Lactic Acid,	1.006	0.796
Glycerine,		0.166

Sohn says that the composition of koumiss varies between the following limits:

Alcohol,	1.0 to 3.0	per cent.
Lactic Acid,	0.6 to 2.5	" "
Milk Sugar,	0.0 to 3.0	" "
Nitrogenous matter,	1.0 to 3.5	" "
Fat,	1.0 to 2.5	" "
Mineral Salts,	0.3 to 0.6	" "

together with carbonic acid gas.

Koumiss is described by the U. S. Federal Standards for dairy products as "the product made by the alcoholic fermentation of mare's or cow's milk." Conn says that an imitation product somewhat similar to koumiss, and so named, is now being widely made from cow's milk. "A small quantity of sugar is added to milk and some common baker's yeast. An alcoholic fermentation soon begins and the fermented product is called Koumiss." It is needless to say that such a product is not koumiss. It is but a base commercial imitation, possesses some of the characteristic by-flavor of the yeast employed and is probably far less wholesome or valuable medicinally than the true koumiss prepared from mare's milk with its own peculiar fermentation and lactic yeast.

Suter-Naef gives the composition of a Swiss imitation of Tartar Koumiss made from the skim milk of cows (the fat in normal cow's milk is objectionable), with sugar and yeast added, as follows:

	Per cent.
Water,	90.346
Alcohol,	3.210
Lactic acid,	0.190
Sugar,	2.105
Albuminates,	1.860
Butter,	1.780
Inorganic salts,	0.509
Free carbonic acid,	0.177

Clarke in his "Travels" describes the "Koumiss and the brandy which the Kalmucks distil from the milk of mares." Clarke found that koumiss was "a kind of sour milk like that used by the Laplanders, called 'Pina' and which has undergone, to a

certain degree, the vinous fermentation; and the brandy, an ardent spirit obtained from koumiss by distillation. In making koumiss they sometimes employ the milk of cows, but never if mare's milk can be had, as the koumiss from the latter yields three times as much brandy as that made from cow's milk."

Koumiss is also sometimes known as "Milk Wine."

### **Leben**

The ancient soured milk of the Egyptians was known and continues to be known as "Leben." It is made from the milk of goats, buffaloes or cows; has a very weak alcoholic fermentation, a characteristic aroma and taste, and the coagulum is coarse and lumpy instead of fine as in Keffir.

### **Matzoon**

This is a drink used largely in Western Asia and Armenia. It is prepared in a somewhat similar manner to Keffir, from goat's, buffalo's or cow's milk and is used partly as a means of souring milk for butter-making and also as a lactic food eaten with spoons. It has a comparatively weak alcoholic fermentation and is made at a higher temperature than Keffir and Koumiss.

### **Araka**

Some of the semi-civilized tribes of Siberia, the Tartars and the Burgatens make and use a strong alcoholic beverage named Araka, from fermented milk, by distillation. Araka contains 7 to 8 per cent. of alcohol and volatile fatty acids. This should not be confused with the Racky, which the Kalmucks distil from koumiss and which Clarke

likens unto "a weak, bad brandy not unlike the common spirit distilled by the Swedes and other northern nations."

### Dadhi

[Douglas says that large quantities of fermented milk are used in India under the name of Dadhi, and its characteristics are not unlike the soured milks of Europe. Chatterjee says that the active specific bacillus of Dadhi is somewhat akin to the Bulgarian bacillus and the bacillus of Leben.] The same authority also gives the following interesting table showing the amount of lactic acid produced by different bacilli in one litre of milk, in terms of lactic acid—the culture being kept at  $98\frac{1}{2}^{\circ}$  F.

Type of Bacillus	After the No. of hours below stated				
	24	48	72	96	168
Bulgarian,	12.8	16.5	20.2		22.
Matzoon,	10.8	12.			
Dadhi,	10.8		11.25	11.70	18.5

### Bulgarian Yogourt

[Bulgarian soured milk is related to the Matzoon of Armenia, the Gioddu of Sardinia and the Leben of Egypt. According to Guerbet, Yogourt incubated for 10 hours at  $113^{\circ}$  F. contains 0.34 per cent. of lactic acid and 0.012 per cent. alcohol. We are told that in Bulgaria, Yogourt is made in nearly every household. The fresh, or sweet, milk is boiled until about a quarter of its volume is evaporated; it is then cooled to about  $113^{\circ}$  F. and the ferment added. This ferment is a portion of Yogourt of approved flavor, and is named Maya. The great reputation acquired by Bulgarian Soured Milk has caused Maya to become an article of commerce and

being the soured milk generally believed to have the most active lactic acid bacteria, it is sent to many countries as a vehicle containing "the bacillus of long life."

Conn in discussing ancient soured milk says "In all cases the beverage is made by ferments which the people prepare by special methods and keep on hand. In many places the ferment is simply a little of the old fermented milk inoculated into the new milk. Most of these forms of alcoholic milk have been studied by bacteriologists and have been found to be based in general upon the same principle. They all represent a combined action of bacteria and yeasts. These beverages are frequently regarded as more easily digestible than ordinary milk and they certainly have a more pleasant flavor. Perhaps their popularity is due simply to the fact that they contain alcohol." The alcoholic content of native Bulgarian Sour Milk is negligible and far too low to cause popularity, and Keffir with only a fifth or a sixth of the alcoholic content of beer, cannot be considered an inebriating drink. Koumiss made from cow's milk may contain about six-tenths of the alcohol found in a similar unit measure of beer, but it is a far healthier and better balanced drink; real Koumiss made from mare's milk contains only about 40 per cent. of the alcohol found in a mild beer. The popularity of the Soured Milk of the ancients and of their descendants, now populating parts of Asia, Eastern Europe and Northern Africa, is due to its wholesomeness, food value, palatability, keeping qualities and its health-giving and body toning properties. The pronounced lactic acid fermentation of soured milks

and not the small alcoholic content have made such substances famous; the use of such lactic acid milks has contributed materially to health and added to life and the average span of years in the communities where they are used. Statistics and scientific investigations and not hysterical superstition and romanticism, suggest therefore that lactic acid soured milk contains a "Bacillus of Long Life and Health." The persistent use of such milks has proved so beneficial to certain peoples that the peculiar lactic media or culture is known as a "Gift from the Gods" and the resultant Soured Milk, to the inhabitants of Western Europe and America, is being looked upon as a sort of panacea for all ills. Physicians are faddists. Of late years, primarily because of the research work of Metchnikoff, they have been advocating the drinking of buttermilk and soured milks for the curing of almost all human ills. This fact is both fortunate and unfortunate; the former because it is far healthier than drugs for almost every physical sufferer; the latter because being used where it should not be used, it may be ultimately discredited and lactic acid milk is too valuable a food drink and too healthful and wholesome a beverage to be thrown into disrepute by the enthusiastic ignorance of doctors, who have the most deplorable habit of catching blindly at some worthy fact or theory, dressing it up and parading it forth as a panacea with wonderful curative or palliative properties. only to drop it abruptly when it loses its power of suggestion on the public and take up some other fad to ride as a hobby to the detriment of a long suffering public. If physicians would take up sane

cures, healthful foods and nature's supplied antidotes for human error, rationally, conservatively and scientifically, they could do a vast amount of good in the world, for the great mass of mankind need to be educated to take proper care of themselves and the majority of people demand that somebody else think, reason and decide for them. But until physicians think for themselves, shun their present parrot and sheep-like tendencies and follow truth instead of superstition, suggestion and the line of least resistance, how can they think for others? The advocacy by the medical profession today of any meritorious food, habit or antidote for error in living, rings the death knell of the thing advocated, for general practitioners persist in making of a thing that is good for certain restricted phases of life, a panacea and cure-all. Their propaganda of bigoted ignorance must ultimately kill any worthy thing, habit or plan, by taking it from its legitimate channel of useful service and thrusting it forth as a universal remedy for all ills and diseases; if it is a medicine, drink or substance to be taken internally, it becomes enveloped in mysticism and savors much of the elixirs of alchemy—thus are worthy substances of nature and excellent habits of life discredited and the world is the loser because of the non-exercise on the part of the medical profession of the mental processes of reason and discrimination.

Since Metchnikoff advocated the use of lactic acid milk to overcome intestinal putrefaction and auto-intoxication, it has been reasoned that lactic acid is lactic acid and that any lactic acid bacteria that has caused the souring of milk must be an

effective means of overcoming auto-intoxication. Moreover, auto-intoxication, or self-poisoning from faulty dieting and putrefaction of waste matter by bacteria in the lower intestine, is reasoned to be the cause of the vast majority of human ills, so everybody must drink sour milk or buttermilk if they wish to maintain or regain health. The concoctions that have been sold in this country, as equal in wholesomeness and medicinal properties to the Bulgarian Yogourt, are almost numberless and the majority of them practically worthless. The dairies have profited by the demand for sour milk and have had opened up to them a splendid market for old skimmed milk and old bad milk. Ordinary sour milk has been named Bulgarian buttermilk, and myriads of other names copying after the famous Sour Milk of the East; drug-stores and milk dealers have indiscriminately soured old and bad milk under most unsanitary conditions and probably not ten per cent. of the Sour Milk sold in this country, with all our opportunities for hygienic and sanitary treatment, has been prepared with as much real cleanliness and protective precautions as is exercised by the Bulgarian peasants who make it in their homes—abodes that do not have by any means any international reputation for cleanliness.

Dr. Wiley, referring to the *imitation* sour milks made in this country, has said that “a natural product produced from natural material is always superior in character both as a food and medicine to the synthetic or artificial product. Whenever a fermented beverage from natural sources is contaminated by artificial products, the resulting compound

is not so useful nor digestible." As an illustration, Wiley says that the genuine Koumiss of the East is a medicinal food of great value and it possesses properties which are lacking in the worthless imitations commonly found in this country. The alcohol in genuine Koumiss is incidental to its fermentation but American Koumiss is sometimes artificially fortified by the addition of alcohol, a practice which must be regarded as extremely reprehensible; moreover, cow's milk as used in this country has neither the chemical composition nor the identical physical properties of the mare's milk used in Eastern Europe, Western Asia and Asia Minor.

### Buttermilk

The residue left in the churn in the manufacture of butter is named "Buttermilk." There are two varieties, viz.: that resulting from the churning of unsoured cream and that remaining after the churning of soured or ripened cream. The first kind of buttermilk is essentially a skimmed milk but the latter has a pronounced acid taste, is wholesome and palatable and is generally known as Dairy Buttermilk.

The composition of the two kinds of Buttermilk is given by Wiley, as follows:

	From Sweet Cream Per cent.	From Sour Cream Per cent.
Water,	89.74	90.93
Fat,	1.21	0.31
Milk Sugar,	4.98	4.58
Protein,	3.28	3.37
Ash,	0.79	0.81
Acidity,		0.80

Other beverages sold under the name of Buttermilk which are produced by the artificial souring of skimmed milk, whole milk, or milks of augmented or decreased fat content, with the aid of appropriate ferments producing principally lactic acid, are not in reality Buttermilk and, it has been truly said, have no claim whatever to the name.

### **Bacteria in Buttermilk and Sour Milk**

The simple fact that milk contains bacteria even in large quantities, does not render it dangerous to drink. The important thing to know is the type and nature of the bacteria present. It has been known for ages that certain forms of soured or fermented milks were healthful products, and sour milk or buttermilk has long been used with success by invalids and even infants. These acid milks contain bacteria in enormous numbers; the bacterial content may be 500,000,000 per c.c. or even more. That such bacteria-laden beverages can be taken, even by children, with benefit, has definitely demonstrated beyond question that bacteria may be useful and their presence healthful as well as dangerous and toxic. Attempts therefore to determine the wholesomeness or harmfulness of milk, based upon the number of bacteria it contains instead of the kind of bacteria, age of milk and treatment which it has undergone, is positively fallacious. The presence of acid bacteria in the human intestines seems necessary to control the normal process of digestion. If these acid germs are not present, the contents of the intestines are much more liable to undergo putrefaction, thus causing auto-intoxication. For this reason the taking of acid organisms into the system seems to be

useful if they can exist until they reach the lower intestines and thrive there to form acid where it is needed in the main colon. Sour milk and buttermilk are usually almost pure cultures of lactic acid bacteria and as such can be used to very great advantage in cases where acid organisms are needed in the intestines.

### **Good Sour Milk a Healthful Food Drink**

Metchnikoff has affirmed that senility is caused to a great extent by auto-intoxication or by the poisons derived from putrefactive micro-organisms which inhabit the lower part of the digestive tract. These organisms increase with age and under faulty dietetic conditions, multiply enormously. His research and experimental work in combating the influence of these harmful microbes, suggested that the tendency to longevity exhibited in certain eastern countries, is due to the steady and maintained consumption of lactic acid organisms which exist in abundance in their soured milks. These organisms being more powerful than those of a putrefactive character, inhibit the growth of the bacteria which thrive in an alkali or neutral medium and which have been proven to be so deleterious to health. Metchnikoff says that it is exceedingly important to combat intestinal putrefaction, for it is an incontestible source of danger which not only causes diseases of the digestive tract but is a source of intoxication of the entire organism. "I have had no illusion as to the difficulty sure to be encountered in any effort to introduce lactic microbes into the intestinal flora which has been preoccupied by a multitude of other microbes. To make sure of the result I chose the lactic microbe which is the strong-

est as an acid producer. It is found in the Yogourt which originates in Bulgaria—the *Bacillus Bulgaricus*. The same bacillus has also been isolated from the 'Leben' of Egypt and it is now proved that it exists in the curdled milk of the whole Balkan peninsula and even in the Don Region of Russia." At birth, the human intestines contain no microbes but they very soon appear. If a child be fed with cow's milk, the intestinal tract contains a greater variety of micro-organisms and many more of them, than is the case if the child is suckled at its mother's breast. As life advances, the intestinal flora varies with the food and this fact makes it possible to adopt remedial measures to modify the flora in our bodies and replace harmful bacteria with useful ones. In popular practice the value of acids for preventing putrefaction has long been recognized. Meats, fish and vegetables can be "kept" in vinegar as the acetic acid in that substance, the product of bacteria, prevents decomposition. If the substances to be preserved give off acids themselves, the addition of some foreign enveloping medium is unnecessary. For this reason some animal products, such as milk, or vegetables rich in sugar, become acid spontaneously and so can be preserved. Soured milk can be made into cheese which will last for a relatively long time. We are told that in Russia, the use of the acidified vegetables is of great importance in the food supply of the populace, as fresh fruits and vegetables cannot be obtained in the long winters and the people consume large quantities of fruits and vegetables which have undergone an acid fermentation in which lactic acid is the chief product. Soured

milk, because of the lactic acid in it, can impede the putrefaction of meat, and Metchnikoff says that in certain countries meat is preserved in acid skimmed milk. Lactic acid fermentation is also important in the food supply of cattle and it is the chief agent in the process of preserving vegetation in silos. Lactic fermentation which serves so well to arrest putrefaction in general, can be used to perform the same function within the digestive tract of the human body. Putrefaction and butyric fermentation are arrested in the presence of sugar but sugar of itself cannot prevent putrefaction. Sugar preserves organic matter from decomposition only because it can readily undergo lactic fermentation and this action is the work of micro-organisms, the discovery of which founded the science of bacteriology. Meat kept in a warm atmosphere soon putrefies; milk, under the same conditions, does not putrefy but becomes sour, the reason being that meat is poor in sugar whereas milk contains a good deal of it and sufficient lactic acid bacteria to feed upon it and produce a wholesome physical change instead of a decomposition into rottenness. Herter, Cohendy, Pochon, Grundzach, Hayen, Belonowsky and a host of other authorities all verify the original deductions of Metchnikoff, that the introduction of lactic ferment into the digestive tract arrests putrefaction; also that intestinal putrefaction is to be combated not by lactic acid itself, but by the introduction into the organism of cultures of the lactic bacilli.

From time immemorial, human beings have absorbed quantities of lactic microbes and thus have unknowingly lessened the evil consequences of in-

testinal putrefaction. Soured milk is frequently spoken of in the Bible. When Abraham entertained the Angels he set soured milk before them. Moses enumerates among the foods which God had given his people "Soured Milk of Kine and Goat's Milk." Such milk—Leben—has been used in Egypt from the remotest antiquity. The famous drinks Koumiss and Keffir of the saddle Nomads and horse breeders, date back to the ages of legend and mythology; both are alcoholic, are difficult to produce away from their native setting and their efficacy depends upon the lactic acid bacilli which they contain in large quantities. Keffir is quite variable and there has been but little success in producing it by pure cultures, moreover the yeasts which it contains are apt to prove somewhat harmful, at times, to those who do not live the free life of the open. Koumiss could be more readily duplicated and if properly made under sanitary conditions, would be a most healthful drink and an admirable substitute for beer. The Bulgarian Yogourt not only contains the strongest and most dependable lactic acid bacillus, but it is quite adaptable; and Bulgarian Sour Milk can be fairly well duplicated in any part of the world provided the proper culture, or Maya, is obtainable. Eastern soured milks, such as Bulgarian Yogourt and Egyptian Leben, are generally made from boiled milk with a prepared ferment added. Metchnikoff has said "From the point of view of flavor I find that soured milk, prepared from raw milk, is much more agreeable. However, we must keep hygiene strictly in view. Raw milk contains a large assortment of microbes and frequently some of them are harmful; the bacillus of bovine tuber-

culosis as well as other pernicious microbes may be found in it. As raw milk nearly always contains traces of faecal matter from the cow, it sometimes happens that pernicious microbes are introduced from that source and remain alive notwithstanding the acid coagulation of the milk. The lactic microbes prevent the multiplication of certain bacteria, but are incapable of destroying them. Prolonged consumption of raw milk increases the risk of introducing dangerous bacteria into the organism, and this possibility drives me to recommend soured milk prepared after heating the raw milk." Heim found, for instance, that the bacillus of typhoid fever remained alive for 48 days in completely soured milk; this is a strong argument in favor of the pasteurization of milk before souring it. Research has proven that in all the well-known Eastern soured milks, the all-important lactic bacilli are associated with a rich flora in which pernicious microbes may be met, hence it seems desirable to attempt to obtain for Western consumption a good sour milk by the aid of virile pure cultures of the lactic bacteria. Rist and Khoury say that Egyptian *Leben* contains a flora composed of five species, three of which are bacteria and two yeasts; the former produce lactic acid and the latter alcohol. Bulgarian Yogourt contains several species of bacteria, but conspicuously among them, and throwing all the remainder into the background, is a very powerful lactic ferment now known as the Bulgarian bacillus which is not only an extremely active producer of lactic acid, but forms neither alcohol nor acetone (two frequent products of bacterial fermentation), and but very small quantities of suc-

cinic and acetic acid and practically no formic acid. The bacillus also differs from other lactic ferments inasmuch as it has no action on albuminoids nor on fats. In order to improve the taste and obtain better all-around results, Metchnikoff has combined with the Bulgarian Bacillus another lactic acid microbe known as the Paralactic Bacillus, and this combination — *Lactobacilline* — is now produced commercially for use in all parts of the world.

In man the colon or large intestine is very largely developed. This organ is of practically no value in the digestion of food and seems to be primarily a receptacle for waste or undigested matter which has been taken into the system as food. The remains of undigested foods and the mucous secretions in the large intestine, form a medium very favorable to the growth of micro-organisms. Strassburger says that there are very few microbes in the digestive or upper portion of the alimentary canal but there is an enormous quantity in the lower part and they increase at the rate of 128,000,000-000,000 per day. This bacterial flora constitutes one-third of the human excreta and is made up of an immense number of different species which flourish in an alkaline or a non-acid environment. The excessive activity of bacteria in any part of the intestines produces putrefactive changes in the waste matter and as a result, poisonous principles are evolved and these find their way into the blood. Lactobacilline, the scientifically compounded culture of Bulgarian Sour Milk, or the prime lactic Bacterium named Bulgarian Bacillus, is an effective means of producing acid in the main

colon so as to control the bacterial flora of the intestines and in this way tend to prevent the formation of toxic poisons; this culture is happily named the *Bacillus of Long Life*. These bacteria are vigorous, multiply with great rapidity and persist in conditions that would be inimical to other micro-organisms. The growth and development of bacteria are interfered with by the products of their own activity; lactic acid producing organisms die when a certain amount of lactic acid has been developed, but whereas the same fate overtakes the Bulgarian bacillus, it survives longer than other lactic acid bacteria and is able, we are told, to produce 2.5 per cent. of lactic acid in milk before it ceases operations. Douglas says, "The soured milk remedy is not a disagreeable one, as, when properly prepared, the article forms both a pleasant and refreshing article of diet. The question of getting the right article, however, is a very important one. Milk is a splendid rearing ground for many bacteria, some of which are very injurious; among these may be pathogenic germs, the seeds of tuberculosis, enteritis, etc. The danger with sour milk is that in the process of culture we develop the best condition for the increase of these when they preponderate, or when, through the use of bad cultures, the lactic acid producing bacteria are present only in small numbers." By the scientific heating or pasteurizing of milk we can eliminate all pathogenic micro-organisms and practically all bacteria. The efficacy and wholesomeness of soured pre-pasteurized milk will then depend entirely upon the characteristics and purity of the culture introduced. Fortunately, pure cultures, now being prepared in a most careful and

scientific manner by specialists, are available for general use and can be obtained for utilization in the home, and home preparation is strongly advocated wherever the consumer cannot be positively assured by milk dealers of the proper treatment of milk and the employment of efficient pure cultures in the souring process.

Soured whole milk is more nourishing than soured skim milk, but there are very many people leading a sedentary life who find difficulty in readily digesting any appreciable quantity of cream or fat. Soured cream is digested with comparative ease, nevertheless there are a large number of people who cannot easily assimilate even soured cream and who need the benefit of lactic acid fermentation. For such, soured milk robbed of its cream or fat content and soured when fresh, or immediately soured after prompt and careful pasteurization, is the ideal and beneficial drink. Such a milk, which can generally be retained when all other foods are rejected, does not have a high calorific value but it contains the normal protein, or tissue-building substances, and the milk sugar, carbohydrates or endurance-producing ingredients of the original milk. Cream, as a rule, contains far more bacteria than the remainder of the milk, and Douglas says "We, therefore, start from a surer foundation when it is removed; besides the mechanical separator, now so largely used, removes slime and other impurities from the milk, and these also are hot-beds of bacteria."

It was noticed some time ago, during research work in regard to tubercle bacilli in market milk, that when guinea pigs were inoculated with cream,

a very much higher percentage died from acute infection than when they were given whole milk, middle milk, bottom milk or sediment. Anderson says that top milk contains from 10 to 500 times as many bacteria per c.c. as the mixed milk. "When milk is centrifugalized, the great mass of bacteria go up with the cream; a lesser number is carried down with the sediment. The skim milk contains many times fewer bacteria per c.c. than the cream or sediment layers. Centrifugally-raised cream contains many more bacteria per c.c. than the gravity-raised cream from the same milk."

The following tabulated synopsis of U. S. Government Tests is of interest:

NUMBER OF BACTERIA PER C. C.

No. of Samples Tested	Gravity		Centrifugalized		Skim Milk	Whole Milk
	Cream Layer	Sediment Layer	Cream Layer	Sediment Layer		
30	69,211,000	4,360,000	.....	.....	.....	.....
26	68,690,000	4,840,000	96,840,000	18,840,000	.....	14,388,000
6	15,416,000	1,405,000	.....	.....	2,050,000	2,708,000
7	.....	.....	4,500,000	725,900	119,700	619,800

The preponderance of bacteria in the cream or fat of milk is of great importance, not only in the use of soured milks but in the use of all milks and particularly in the use of top milk for infant feeding. The various bacteria causing acute infections are more numerous in the top milk than in the bottom milk. In many cases this difference is more than a hundred fold and as infection must depend to some extent on the number of bacteria introduced into the body, too little attention is being given to the question of bacterial content in top milk for infant feeding, particularly in the summer-time.

Sour milk without cream is without doubt particularly good for all people who eat heavily and exercise little. It has been proved to be good for the active roving Nomad; it must be many fold more beneficial to the muscularly lazy western meat eaters. Such milk can be taken at any time, between, before or after meals. It is beneficial to the entire digestive tract and is salutary for the liver; it is particularly efficacious for arterialsclerosis, i. e. hardening of the arteries, which has been termed the "Disease of Old Age," and is of benefit in certain kidney diseases, for the kidneys and the liver are the natural guardians of the body against the toxins which enter the blood from the intestines; auto-intoxication injures and over-stresses these and other kindred organs. Sour milk tends to neutralize the bad effects of alcoholism, of faulty dieting and operates to overcome many of the evils of our artificial civilization with its unnatural mode of life.

### **The Use of Milk**

Milk properly modified is the prime food of the very young and should be used as an important part of the diet of the very old. It is often referred to as the "ideal food" but in so far as its application to the feeding of adults is concerned, the description exceeds the truth; and cow's milk for both the very young and the old generally needs modifying to make it acceptable and adaptable. Milk occupies an intermediate position between a drink and a solid food; it is a liquid food, too nutritious for a beverage and too dilute to replace solid nourishment for an adult. It is, moreover, not of suitable chemical composition to nourish the human

body efficiently and agreeably for long periods of time and the true function of milk for adults should be the enrichment of a diet otherwise poor in fat and protein. Milk should be an invaluable component part of the general diet of adults but more should never be expected of it. As milk is heavily charged with solid matter it should not be used as a drink in the ordinary sense of the word, but with a proper appreciation of the fact that it is both food and drink. Milk should always be sipped and no person can take, copiously, draughts of milk without ultimately experiencing discomfort. If milk is gulped down in large quantities, it is apt to coagulate in lumps and digestion is much interfered with, but if it is taken slowly, it coagulates—i. e. the casein is curdled by rennet—in small pieces which are readily attacked by the gastric juice and milk is then one of the most assimilable of foods. Nature provides that the milk of young animals is supplied in finely divided streams so that coagulation takes place in the best possible way and digestion is accomplished without embarrassment.

Lorand says that a diet consisting of milk alone is one-sided, since only one kind of food is taken and for a normal person, a one-sided diet is not in any way advisable as it has the same effect as insufficient nutrition. "An adult person can get on very well with milk only during a certain time and when persisted in, this mode of nourishment is quite as injurious as any other one-sided diet. Milk when taken alone is not fully assimilated; about 18 per cent. of the food is lost through faulty assimilation. As much as four quarts of milk would have

to be taken daily to thrive upon this diet. When bread and cheese is added, the assimilation is much better for the diet is no longer one-sided, and persons who are heroic enough to live in this way, or who are compelled to do so, may be sure of a long life."

Lorand has described old age as a chronic disease due to degeneration of the glands, with their internal secretions, generally described as ductless glands, such as the thyroids, adrenals, etc. He maintains that such degeneration is amenable to treatment just as are chronic diseases in general and advocates the use of milk as an article of diet, affirming that milk "excites the activity of the thyroid gland, owing to its content of the internal secretion of the thyroid which passes the milk." We therefore find that both of the new scientific schools for combating old age by hygienic and therapeutic measures, advocate the use of milk. The Metchnikoff School believes that the lactic acid bacillus found in milk, and particularly in sour milk, functions in the lower intestine to overcome the bacteria of putrefaction and tends to reduce the evils of auto-intoxication, or self-poisoning. The Lorand School believes in measures to prevent or retard the atrophy of the ductless glands of the body and are of the opinion that the use of milk, while not their prime remedial measure, is nevertheless of great benefit in stimulating the thyroid glands, thus functioning to postpone old age as well as nourish the body. Lorand has said that the aged cannot "be transformed into sprightly adolescents and it is impossible to create a young man out of an old one, but it is quite within the bounds of possibility

to prolong our term of youthfulness by ten or twenty years." Both Lorand and Metchnikoff believe that man should not grow old at forty or fifty but should live to the age of ninety or one hundred years instead of dying at sixty or seventy, and both advocate the use of milk as an article of diet.

It has been said that there is no article of diet which exerts so marked a protective influence upon our organs as milk. By virtue of the absence of a large amount of extractive substances, milk does not tax the liver, kidneys and blood vessels with irritating matter. Milk does not form uric acid and can be taken advantageously by sufferers with gout, rheumatism and kidney trouble. It is an up-building food drink and of great value in cases of consumption and anaemia. Some persons possess an antipathy to milk which in its ordinary form cannot be well tolerated. In such cases the milk should be diluted about one-third with some alkaline mineral water, such as vichy-celestins, or possibly modified in regard to fat content and taken with or without vichy of lime water. For those who apparently cannot tolerate ordinary milk, the more easily digested buttermilk or sour milk, without cream, should be taken.

Hot milk is a better and more healthful stimulating drink than tea, coffee or chocolate. It is valuable for breaking up a cold, opening the pores of the skin and increasing the circulation and can at times be used for a good substitute for alcohol. The ideal diet for men and women leading a sedentary life is composed of milk, eggs and vegetables—using the latter word in its broadest sense. Occasional digressions to avoid monotony and the

very temperate and incidental use of meat, will do the average person no harm; but the diet of every human being should be arranged both as regards quantity and quality with special reference to the physical work to be performed and in harmony with the general mode of life. Over-eating and over-drinking is a curse of the times. Men and women should not degenerate into dietetical faddists and bigoted extremists, but should take as food and drink that which is needed to sustain life effectively and is supplied for the purpose by Mother Nature, positively shunning the more that clogs but also avoiding the less that depletes.

### III.

#### TEA, COFFEE, COCOA AND CHOCOLATE

##### (CAFFEINE DRINKS)

##### **Nature of Certain So-called Temperance Drinks**

Tea, coffee, cocoa and chocolate are generally classed as pleasurable, stimulating drinks, but they have become popular, not because of their pleasant taste but because of their stimulating action. Such so-called "temperance drinks" are used in quantity because they are "drugged" waters.

##### **Effect of Drugs and Stimulants**

The effect of drugs upon the cells of the human body is to stimulate them, to depress them or to change and destroy them. By stimulation the power or readiness of the cells to functionate is increased, by depression such power is decreased and cessation of the power to functionate causes paralysis. Many drugs have the effect of producing irritation which is anatomic rather than functional and tends toward a harmful change in cell structure. A stimulant is an agent which increases vital action in the organ to which it is applied or in the system generally. It has been defined as "an agent which produces a quickly diffused and transient increase of vital energy and strength of action in the organism or some part of it." To stimulate means not to physiologically nurture and strengthen but to excite, spur onward and rouse or

animate to more vigorous exertion by some pungent, persuasive or irritating motive and prolonged or excessive stimulation may result in depression or physical breakdown and paralysis. The word "stimulant" is derived from a word meaning a goad or a pointed instrument used to urge on a beast by the infliction of pain. To stimulate the human system is meant to spur or goad it forward to increased effort; to excite or irritate it to more energetic reaction by what must generally be considered as distressing and harmful abuse. A tonic is intended to increase strength by raising the tone of the system but a stimulant cannot, pathologically, be a tonic, for it does not build up but rather provokes, incites and therefore weakens the system because of the excessive and unnatural demands made upon it. In sickness a stimulant may function beneficially when used pathologically as an emergency measure, but in health the habitual use or immoderate use of any form of stimulant is fraught with much danger. No horse could work acceptably to itself or its owner if persistently or abusively prodded with the spur or goad and lashed with the whip—and man is subject to the same laws of nature as any other living thing.

There are certain stimulating drugs whose chief action is upon the central nervous system. Such drugs include caffeine, cocaine, nux vomica, strychnine and atropine. The caffeine group consists of the three alkaloids: caffeine, theobromine and theophylline. They are purin bodies and are closely related to Uric acid. Coffee contains caffeine; tea both caffeine and theophylline, and cocoa or chocolate, theobromine, and these alkaloid drugs of the

caffeine group are what make such drinks popular. The effect of such drugs upon the nervous system is that of continued stimulation or excitation and their continued, excessive use overworks and wears out the body cells causing deterioration of both body and mind. Coffee, tea and kindred drinks are, therefore, stimulating irritants. Tea, in addition to its caffeine content, contains a large percentage of tannic acid, an astringent. One can form some idea of what the stomach of the excessive tea consumer has to contend with when he reflects that tannic acid is the essential element used in tanning leather. Many of the most bigoted advocates of temperance (which term has been corrupted and abused to mean alcohol abolitionists) are intemperate drinkers of tea or coffee and slaves to the drug caffeine. Many a person who condemns the temperate or occasional use of alcohol in any form, uses caffeine as a whip or goad to stimulate his mind and body to increased vital energy. Alcohol taken habitually or to excess, is positively injurious, but equally injurious to bodily health is the excessive, persistent use of caffeine, particularly when it is administered in the form of strong tea ignorantly prepared. There are towns in Britain where the children, fed primarily on bread with copious draughts of tea, are in such a deplorable physical condition, with dwarfed minds and emaciated frames, that one is tempted to prescribe mild pure European beer for them, even with its three per cent. of poisonous alcohol in lieu of their so-called harmless national drink,—drug-laden and abominably made.

**Sources of Caffeine**

The discovery by the inhabitants of various countries of the value of some particular plant in making a stimulating beverage is rather interesting. Caffeine is found in plants growing in different parts of the world. In Arabia and Egypt the caffeine-laden beverage is made from the roasted seeds of coffee; in Western Africa from the dried seeds of kola; in the Amazon region of South America, from guarana, a brittle mass made by pounding the seeds to a paste and drying by heat; in China and Japan it is generally made from tea; in Paraguay and Uruguay, from maté, the dried leaves and shoots of a species of *ilex* or holly. Having no caffeine plants, the inhabitants of Mexico and the West Indies have made their stimulating beverage from the fermented seeds of the chocolate plant which contains the close relative, theobromine. Bastedo says that maté contains about 1.3 per cent. caffeine, kola 1 to 2 per cent. and guarana 3 to 6 per cent., the latter also containing much tannic acid. Commercial caffeine is usually made from damaged tea leaves; and citrated caffeine, used medicinally, is a mixture of equal parts of caffeine and citric acid. Most of our coffee comes from Brazil, our tea from Japan, China and India, and our chocolate from the West Indies.

**Caffeine and Tannic Content of Tea**

The average caffeine and tannic content of teas, according to Tatlock and Thompson, are stated as a percentage in the following table:

Growth	Tannin	Caffeine
Indian Teas,	14.33	3.45
Ceylon Teas,	12.29	3.25
China Teas,	9.50	3.00

The flavor of Chinese Teas is in general weaker but more delicate than that of Indian or Ceylon Teas, the best qualities being considered very fragrant.

According to Koenig, the tannic acid content and other constituents of black and green teas are:

Tea	Nitrogen Per cent.	Theine Per cent.	Tannic Substance Per cent.
Green,	4.78	1.7	16.8
Black,	4.58	2.3	15.2

Tea contains the following salts—an analysis of the ash:

	Per cent.		Per cent.
Potash,	37.50	Magnesia,	5.71
Lime,	13.71	Iron Oxide,	4.47
Soda,	8.01	Chlorine,	1.69
Phosphoric Acid,	7.57	Manganese Oxide,	1.05

Volatile essential oils in tea impart the flavor and odor. Green tea is made from the younger leaves and such tea contains more volatile oil, more tannic acid and less caffeine than black tea; it is therefore, less stimulating and more astringent. Bannister made some tests on black teas that averaged 3.24 per cent. of caffeine and 16.4 per cent. of tannic acid, while his tests on green teas gave an average of 2.33 per cent. of caffeine and 27.14 per cent. of tannic acid. It is claimed that in the preparation of tea leaves for the market, about half the tannic acid is lost and this may explain the greater variation in the findings of experts in regard to tannic acid content of teas.

Tannic acid is particularly injurious to the stomach; English investigators have found that it retards the digestion of starches. Roberts recom-

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mends that a small quantity of bicarbonate of soda be placed in the tea cup when the tea is taken and that it never be taken on an empty stomach. Tea should not be boiled as this hastens the solution of the tannic acid (deleterious to health) and drives off the flavoring oil. If tea is allowed to steep too long the beverage becomes deeply colored and rich in tannic acid. The tea which stands all day long in the tea pot—as often seen in Britain—is essentially a solution of tannic acid which would effectively tan hides into leather. The bitter taste of old and strong tea is due to the tannic acid passing into solution. Some teas run as high as 5 per cent. in caffeine and range from 2 to 5 per cent.; mineral matter varies from 5 to 9 per cent., moisture 5 to 10 per cent., and the balance is cellulose, resin, gums, pectin, protein, sugar, etc.

### Tea Adulteration

The adulteration of tea with chemicals or foreign extraneous matter is seldom encountered in these days. There are some notable defects, however, occasionally met with, such as the percentage of stalk sold with the dried tea leaves. Dr. Besson of Basle has made very complete investigations in regard to the "stalk content" of teas with the following results:

	Per cent.	Average
China Green Tea contained	0.4 to 5.3	3.1
Foochow Tea	4.1 to 17.5	9.3
Hankow Tea	8.6 to 17.1	10.9
Java Tea	4.4 to 29.9	19.9
Indian Tea	11.5 to 37.4	24.0
Ceylon Tea	5.8 to 43.4	25.7

**Analysis of Coffee**

Roasted coffee contains 0.6 to 2 per cent. of caffeine, or about one-half to one-third as much as tea—a fact not generally known. Caffeol, a volatile oil, is developed in roasting. It is the source of the flavor and aroma of the coffee and is so penetrating that a single drop of it will fill an average sized room with the coffee odor. Tannic acid appears in coffee as caffeotannic acid and is entirely different from the tannic acid of tea, for it is not an astringent and does not precipitate albumin, gelatin and alkaloids; it tends, however, to check digestion and retard absorption. The other ingredients of coffee are sugar, fat, protein, dextrine, fibre and mineral salts.

Three sets of analyses of coffee for caffeine content gave the following results:

Arabian,	.7 to 1.6 per cent.
Liberian,	1.0 to 1.5 “ “
Sierra Leone,	1.52 to 1.7 “ “

The composition of coffee—when roasted—is according to Koenig:

Ingredients	Per cent.	Ingredients	Per cent.
Protein,	12.64	Dextrine,	1.31
Caffeine,	1.16	Tannic Acid,	4.65
Fat,	13.85	Other carbohydrates,	39.88
Sugar,	1.31	Cellulose,	18.07

The ash content is stated as follows:

Salt,	Per cent.	Salt,	Per cent.
Potash,	61.47	Sulphuric Acid,	3.80
Phosphoric Acid,	13.39	Iron,	0.65
Magnesia,	9.69	Silicic Acid,	0.54
Lime,	6.19		

### Use of Coffee and Tea

The French *Café au lait* is half coffee infusion and half boiled milk. This beverage is only suitable when not too much solid food is consumed at the same time, as in the French early breakfast; it is less suited to the more substantial American or British breakfast. Under the name "French Coffee," chicory is used as an adulterant. Roasted chicory has a much less pleasing flavor than coffee and is devoid of caffeine. Chicory, however, is not the harmless adulterant that it is generally supposed, for Swintz has shown that it has a "markedly unfavorable effect upon growth and development." As far as the stomach is concerned, coffee generally causes much less injury than tea, especially where there is hyperacidity. Both tea and coffee cause an increase of blood pressure and should be forbidden in arteriosclerosis and heart weakness. Coffee is an antidote for certain poisons, such as opium and alcohol. Dr. Lorand advocates the use of hot cream or hot milk when coffee is taken and total abstinence in regard to thick, black coffee unless it be a very small cup for people without conscious nerves, taken at the end of a meal. He also adds, "Coffee, owing to its property of stimulating the intellectual activity and of removing fatigue, is often greatly misused by brain-workers. While it does for a time brace one up for working, the work is paid for with interest by the wear and tear, so to speak, of the important organs of the body." Schumburg has proved that when the muscles have already become exhausted, caffeine does not have any effect. Coffees from which the caffeine has been extracted are on the market. Their use is undoubtedly much less harmful than

straight coffee, but caffeine is not the only deleterious ingredient in coffee, and there are drinkers of non-caffeine coffee who have experienced the ill and poisonous effects of coffee after drinking a few cups of the caffeine-freed beverage.

It is well to keep in mind that the average family making tea and coffee will use almost twice as much coffee per cup as tea, although some people (British) drink tea at times so strong that "it stands without a cup", and in New Orleans coffee is made black and of a syrupy consistency. Bastedo says that the amount of tea used in making a cup represents 1 to 2 grains of caffeine and the coffee per cup  $1\frac{1}{2}$  to 3 grains. Tea leaves, he says, contain far more caffeine than coffee, but much less tea is used per cup. Cushny says that a cup of coffee is equivalent to  $1\frac{1}{2}$  to 3 grains of caffeine, and a cup of tea may be considered to contain the same amount of caffeine, so apparently Cushny likes his tea stronger than Bastedo, or else Bastedo used a tea cup for his tea and Cushny used the same sized coffee cup for both calculations. Hollingsworth says that the average cup of tea contains about 1.5 grains of caffeine; an after-dinner cup of black coffee, the same amount; an average glass of cold green tea about 2 grains, and an average cupful of coffee with two-fifths hot milk, 2.5 grains of caffeine. Such figures are, however, of little value unless we know the strength of the solution and the size of the cup. Fortunately both tea and coffee, particularly the former, are being taken to-day very much weaker than formerly. The stronger the tea and coffee, the more injurious it will be to the system, the more poison will be absorbed and the greater will be the effect upon the nerves, heart,

stomach, liver and kidneys. The majority of people crave a hot drink in the early morning. A hot drink is stimulating, cleansing and satisfying, hence the hot drinks in general use are taken, and to obtain the benefit of hot water, drugs which increase the degree of stimulation are taken with it. Coffee and tea are in the majority of cases used because they are the only available hot drinks; hot water of itself is not very palatable and hot milk is seldom considered. The heat in the morning cup of coffee has been termed "coffee's good angel" and the caffeine, tannic acid and volatile oils of tea and coffee have been termed the "bad demons" of the exhilarating morning cup.

#### **Comparative Use of Coffee and Tea in Various Countries**

America is a great coffee-drinking and a low tea-drinking country, and Great Britain is a great tea-drinking and a low coffee-drinking country, as the following figures will show:

	Consumption in lbs. per head, per annum.	
	Coffee	Tea
United States,	11.5	0.89
Great Britain,	1.0	6.17
Germany,	6.7	.11
France,	5.0	.06
Holland,	14.5	1.45

New Zealanders among the white races hold the record for tea drinking, their consumption being 7.45 lbs. of dry tea per head; then follows Australia with 6.83 lbs.

The United States consumes nearly one-half the coffee of the world, although exceeded per person in consumption by Holland and Scandinavia. When we consider the tea consumption in the Far

East the statement that "tea is the world's greatest drink, next to water" is probably true. Occidentals have never learned the art of making tea; as prepared by the Orientals it is far less injurious to health than the decoctions made from tea leaves by the Caucasian Race.

### Cocoa and Chocolate

Cocoa which contains the drug theobromine of the caffeine group and was enthusiastically named by the celebrated Swedish scholar Linné "theobroma"—a gift of the gods—is yearly becoming more popular as a beverage; in four years its consumption increased 70 per cent. in the United States, 61 per cent. in Germany and 40 per cent. throughout the world. The cocoa pulp contains approximately

	Per cent.		Per cent.
Albuminoids,	6	Starch,	7
Alkaloids,	2	Coloring Matter,	4
Fat,	2	Tartaric Acid,	3
Sugars,	6		

The following table by Koenig gives the results of his analyses of cocoa, free from oil:

Substance,	Per cent.	Substance,	Per cent.
Protein,	20.43	Starches,	15.60
Fat,	28.34	Other carbohydrates,	17.70
Theobromine,	1.88	Cellulose,	5.37

The composition of the Ash is reported as follows:

Salts,	Per cent.	Salts,	Per cent.
Potash,	31.43	Iron Oxide,	0.14
Soda,	1.33	Phosphoric Acid,	30.46
Lime,	5.07	Sulphuric Acid,	3.74
Magnesia,	16.26	Chlorine,	0.75

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Chocolate made from cocoa, according to Koenig, contains—

Substance,	Per cent.	Substance,	Per cent.
Protein,	6.27	Sugar,	53.70
Theobromine,	0.62	Starch,	4.07
Fat,	21.20	Other carbohydrates,	5.59
Tartaric Acid,	1.36	Cellulose,	1.67

Chocolate is, therefore, theoretically a nutritious food and may possibly be used to advantage by those engaged in strenuous work, such as mountain climbing. It is fattening but not generally acceptable to those engaged in a sedentary occupation. It poisons some adults in a pronounced manner, causes skin eruptions, upsets digestion and retards the secretion of gastric juice and the motor functions, i. e. the emptying of the stomach. Neumann has proved that chocolate or cocoa detrimentally affects the absorption of the protein and the fats of food; if taken in quantity, it will cause headache with a depressing feeling of heaviness and abdominal discomfort; its continued use tends to cause dyspepsia. Chocolate has a high food value because of its sugar content. Cocoa made with milk is nutritive, but so is coffee, and this is due to the milk in the beverage. Cocoa beans considered apart from the fat which they contain are not a prime food and are scarcely more entitled to the term than is tea or coffee, for cream (fat) can be used with coffee if one so elects. Sohn says that 60 per cent. of the protein in cocoa is unassimilable, and of the non-protein components, the fat alone is readily digestible. "We do not eat tea leaves and coffee grounds, but because we swallow ground cocoa beans, we regard them as food."

Chocolate or cocoa should never be given to young children, and it is too fat, rich and heavy for invalids. Cocoa as a beverage has an action somewhat similar to that of tea and coffee, but it does not possess the same exciting, stimulating action of caffeine on the nervous system and it may, therefore, be taken (especially when made with milk) where coffee and tea produce wakefulness. The theobromine of cocoa stimulates both cardiac and voluntary muscles and has diuretic power; it therefore acts like caffeine upon the heart, kidneys and muscles, although kidney tolerance with cocoa is soon established so that the habitual cup is apt to result in the loss of its diuretic power.

### Maté

Maté, which is a tea made from the leaves of a kind of prickly holly growing in Paraguay and Southern Brazil, is less exciting to the nervous system than Oriental tea. French investigators say that it accelerates the circulation of the blood, diminishes fatigue consequent upon muscular exertion and also prevents the sensation of hunger without affecting the appetite. Koenig gives the contents of maté as follows:

Protein,	11.20 per cent.
Theime,	0.89 " "
Tannin,	6.89 " "
Tannic Acid,	4.5 to 9.6 " "

Maté, therefore, contains about half as much caffeine as Oriental tea, and when brewed has the general properties of a weak tea.

### Effects of Caffeine Drinks Upon the System

There is a great difference in the nature of the three great international non-alcoholic drinks.

With tea and coffee we drink an infusion of leaves and berries, but with cocoa the whole material is taken in a state of very fine suspension, and the cocoa bean, even with the fat extracted, has some nutritive value. Caffeine has no effect upon the peristaltic movements of the intestines, but coffee is somewhat of a laxative, while tea tends to constipate. The greater the tannic acid content of any of these beverages, the more pronounced becomes the resulting gastric and digestive disturbance. Caffeine and theophylline also affect the gastric action by causing irritation of the mucous membrane. Coffee, tea and kindred drinks do not lessen the tissue change of the human body, as has been claimed, but rather increase it, the amount of urea and carbonic acid excreted being considerably augmented by their use; they act consistently, therefore, as drug stimulants and are void of nourishing and up-building power.

### CAFFEINE DIURESIS IN A RABBIT

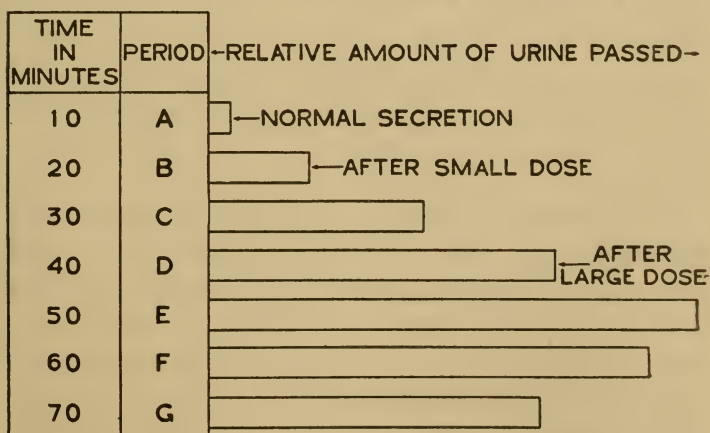
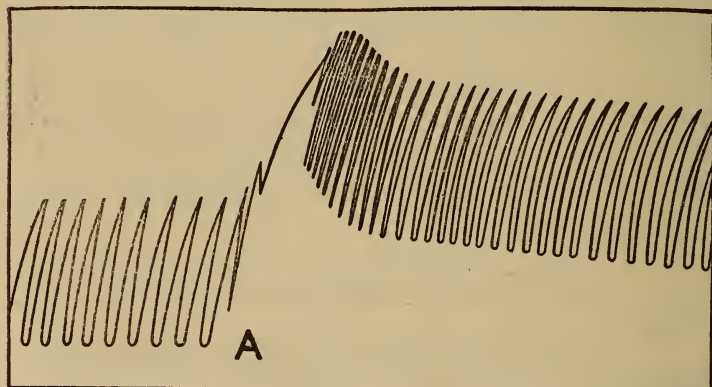


FIG. 20.

In their action on the kidneys, the members of the caffeine series of drugs stand pre-eminent, no other drug producing such a copious flow of urine as either caffeine or theobromine. The foregoing chart shows the Caffeine Diuresis in a rabbit. The amount of solids in urine was increased about 5 fold and the blood pressure was slightly lowered.

The effect of caffeine upon the respiration is also vividly illustrated by the following diagram. The respiration of a rabbit having been slowed by morphine, caffeine was injected intravenously at A, the respiration being at once greatly accelerated.



RESPIRATION OF A RABBIT ACCELERATED BY CAFFEINE

FIG. 21.

Caffeine as found in tea and coffee is chemically related to uric acid, and copious draughts of such beverages with heavy meals tend toward uric acid troubles and rheumatism. Caffeine stimulation is one of the most prevalent causes of headache and it is also popularly associated with biliousness. Professional tea tasters are melancholy examples of the deleterious effect of tea upon the human sys-

tem. It has been reported (at this time of writing the authority and date for verification are not available) that a European Government, many long years ago, divided a number of criminals condemned to death into three squads, withheld all solid food and gave day after day to one squad cocoa only, to another tea, and to the third coffee. The report says that, contrary to expectations, the drinkers of cocoa succumbed first, being followed by the tea drinkers, with the coffee drinkers last.

The effects of stimulating drugs of the caffeine group, as administered to the system in the form of popular beverages, have been studied by many learned investigators. After a fair dose of caffeine the mind seems to become more alert, the attention keener and the spirits brighter, hence tea is known as "the cup that cheers but not inebriates," and it is used as a favorite resort to brighten the gossip of an afternoon call or to remove the feeling of fatigue. Coffee, moreover, is quite generally used in many countries, including our own, as a morning's "pick-me-up," a "bracer" or "wake-up" drink, lashing the mind and body forward to perform the tasks of the day. Caffeine stimulates the intellectual functions, renders the perceptions more acute and excites to activity. Kraepelin found that caffeine facilitated the reception of sensory impulses and the association of ideas, but the transmission of thought into action was retarded. His tests indicated that caffeine produced acceleration in arithmetical addition, retardation in speed of memorizing numbers and increase in speed of reading. He concludes, "The picture of the tea influence which we have secured agrees in all essential points with the experience of daily life. We know that

tea and coffee increase our mental efficiency in a definite way and we use these as a means of overcoming mental fatigue. In the morning these drinks remove the last traces of sleepiness and in the evening, when we still have intellectual tasks to dispose of, they aid in keeping us awake. In large amounts and in the case of sensitive persons their ingestion delays sleep."

Bastedo, writing of the toxicology of caffeine says that when a moderate dose of caffeine is taken, such as two or three times the accustomed amount of coffee or tea, the brain and cord become overactive and there are increased reflex irritability, increased motor activity and impairment of the mental powers because ideas follow one another so rapidly as to prevent concentration of thought. The subject cannot concentrate his attention and is excitable, restless and unable to sit quietly. His muscles twitch and he may feel gastric (stomach) discomfort with oppressions about the heart and palpitation; his breathing may be deep but oppressive; confusion and headaches are common and noises in the head or a mild form of delirium may be experienced. Larger doses may be accompanied by vomiting, convulsions, weak and irregular heart, low arterial pressure and collapse. Death takes place usually from failure of the heart muscle, but may be due to exhaustion of the respiratory center. Sollmann and Pilcher report that alcohol increased the toxicity of large amounts of caffeine, though caffeine does not increase the toxicity of alcohol. This is reasonable, for alcohol, a narcotic, would be somewhat neutralized by caffeine, a stimulant; caffeine taken in marked toxic doses abuses the body, expends its forces, dissipates its reserves; and if

alcohol, a narcotic, is fed to a body suffering from extreme caffeine fatigue and ultimate exhaustion, the result must of necessity be particularly harmful.

Many tests have demonstrated that caffeine tends to make ideas become clearer and thought flow more easily and rapidly, but not infrequently *connected* thought is rendered more difficult, as the impressions are apt to follow each other so rapidly and at such an abnormal pace that the attention seems to become distracted.

Leistenstorfer, experimenting for the German Government, found in comparative tests that whole companies of soldiers could endure more prolonged and severe marches, if given tea and coffee, than those who did not receive such drinks, provided that they were all well supplied with food. If no food was supplied, fatigue appeared first in the tea and coffee drinkers. Therefore, tea and coffee increased the power for continuous physical work as long as the supply of nutritive material was ample, but caused early exhaustion when food was withheld. Schumburg also found that coffee and tea have no recuperative power over the muscles of a fatigued organism, except when taken with other foods, and Hellster, exercising before breakfast, found that the effect of taking tea was negligible. Larger quantities of caffeine generally cause headache and some confusion, and even a mild form of delirium may be elicited.

#### **Mechanical Tests to Determine the Effect of Caffeine**

The investigations of scientists since 1892 have generally demonstrated the stimulating effect of caffeine on ergographic performance, the drug being administered in such various forms as caf-

feine, tea, coffee, kola, maté, guarana and theobromine. Only one investigation reported, failed to find an appreciable effect, but Feré affirms that the effect is only an acceleration of fatigue. Kraepelin and Hoch have investigated the influence of the chief constituents of tea and found that both the caffeine and the essential oils have a stimulating effect. Rivers found that caffeine increased the speed of performance in typewriting, but had no influence on the accuracy. He was also the first investigator to fully appreciate the genuine and practical importance of thoroughly controlling the psychological factors that inevitably play an important rôle in all such experiments. Many tests have shown that fair-minded subjects, fed with sugar capsules, have been somewhat stimulated in their work, acting under the impression that the capsules contained caffeine. Rivers' general conclusions are that caffeine increases the capacity for both muscular and mental work. When taken to excess, the stimulating action may be so transitory and followed by so great a decrease that it may legitimately be spoken of as an acceleration of fatigue. "The experiment suggests strongly that caffeine is a dangerous remedy as a stimulant in cases of prolonged fatigue or of that enhanced tendency to fatigue which is the characteristic feature of neurasthenia."

#### **The Hollingsworth Tests of Caffeine Effect**

Hollingsworth, instructor in psychology at Columbia University has made the most thorough investigation recorded, in regard to the effect of caffeine upon the human mental and motor processes. These tests were financed by the Coco-Cola Com-

pany of Atlanta, Ga., which would seem to indicate that caffeine is not unknown in the production of "healthful" and popular soda fountain beverages. The Hollingsworth Tests were conducted with 16 subjects, ten men and six women, and occupied a period of forty days. The subjects were teachers and students or wives of teachers and students and varied in age from 19 to 39 for the males and 27 to 39 for the females. Of the 16 subjects, three were abstainers from caffeine, three were occasional and two were moderate users and eight were regular drinkers of coffee and tea. There was a great variation in the weight of the subjects, viz. 105 to 193 lbs., and it has been proven that the effect of caffeine in regard to certain processes varies almost directly as the weight of the user. In order to reduce to a minimum the factor of sensory or psychical stimulation, caffeine and an inactive substance (sugar of milk) was administered to all subjects in capsule form, and both substances—the caffeine and the control—presented the same appearance, neither substance being tasted. The fact that the caffeine days were thus unrecognizable helped to reduce the disturbing influences of excitement and interest. These factors were further reduced by administering to all subjects the control, or sugar of milk doses, for one week without their knowledge.

The Hollingsworth Tests and the general results obtained can be briefly described as follows:—

*Tapping Test (1).*

Each subject was required to execute 400 taps as rapidly as possible with a metal rod on a solidly planted metal base, each tap making an electric contact, automatically recorded.

In this test the average normal rating was 99.1. The caffeine was administered in the middle of the morning, at noon, 3:10 P. M. and 5:30 P. M. Tests gave the following average results for variable doses:

1 gr. Caffeine,	97.5
2 gr.       “	97.1
4 gr.       “	98.6
6 gr.       “	95.6

The average caffeine numeral was 97.2 and the average reduced time, due to caffeine stimulation, 1.9 per cent. When the caffeine was taken at 1:00 P. M. with lunch, the effect on the 3:10 P. M. test was not especially marked except with the 6 grain doses. The 5:30 P. M. test showed considerable effect, varying in extent with the size of the dose.

1 gr. Caffeine resulted in	6.5 per cent. reduced time
2 gr.       “       “       “	3.6   “   “   “   “
3 gr.       “       “       “	4.8   “   “   “   “
4 gr.       “       “       “	10.1   “   “   “   “
6 gr.       “       “       “	13.8   “   “   “   “
Average Caffeine doses,	7.7   “   “   “   “

When caffeine was taken at 1:45 P. M., or two hours after eating an early lunch, the following results were obtained at each of two afternoon test periods:

	Percentage of Reduced Time	
	3:10 P. M.	5:30 P. M.
1 gr. Caffeine,	3.56	0.18
2 gr.       “	3.35	3.17
3 gr.       “	2.86	2.92
4 gr.       “	3.15	1.57
6 gr.       “	1.17	6.55
Average Caffeine Tests,	2.82	2.88

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At 7:45 the next morning the subjects taking the large 4 and 6 grain doses showed the effect of reaction from over-stimulation or fatigue and their increased time on the Tests was 1.36 per cent. Comparing the work done after a dose of caffeine on any given day, with the work done on that same day before the administration of the dose we find:

	Difference		
	Before	After	Per cent.
4 Sugar of Milk or pseudo- caffeine subjects,	1.014	.992	.022
3 subjects in one squad given 1 to 6 grains of caffeine,	.986	.932	.054
5 subjects in a separate squad given 1 to 6 grains caffeine	.995	.968	.027

Apparently the psychical effect plays an important part in all such tests as the above figures show.

Hollingsworth's summary of these Tapping or Motor Tests are:

- (a) That the typical caffeine effect on a motor process seems to be a stimulation which is sometimes preceded by a brief and slight initial retardation.
- (b) The magnitude of this stimulation varies directly with the size of the dose, and is relatively slight when the caffeine is taken in the forenoon.
- (c) The effect begins 45 to 90 minutes after the administration of the dose, the period being shorter for large doses and longer when the dose is taken with food.
- (d) The effect persists for from 1 to 2 hours for doses of 1 to 3 grains, and as long as 4.5 hours for 6 grains.

It was found that giving 6 grain capsules, after days of abstinence from caffeine, produced "a great irregularity of performance, six of the subsequent

trials breaking all of the morning records and three of these being among the poorest records of the day. The general tendency is toward stimulation, but this stimulation is mixed with an irregularity of performance" or what can be fittingly termed erraticalness and instability.

### *Co-Ordination Test (2-3).*

The Three-Hole Test for combined accuracy and speed was used and this test includes along with the factor of steadiness and rapidity, which are essentially motor or physiological, the more strictly mental factor of co-ordination. The test involves the insertion of a rod into each of three holes, successively, as rapidly as possible until 100 insertions have been made and time recorded. The effect of small amounts of caffeine was stimulation, while that of large amounts was retardation.

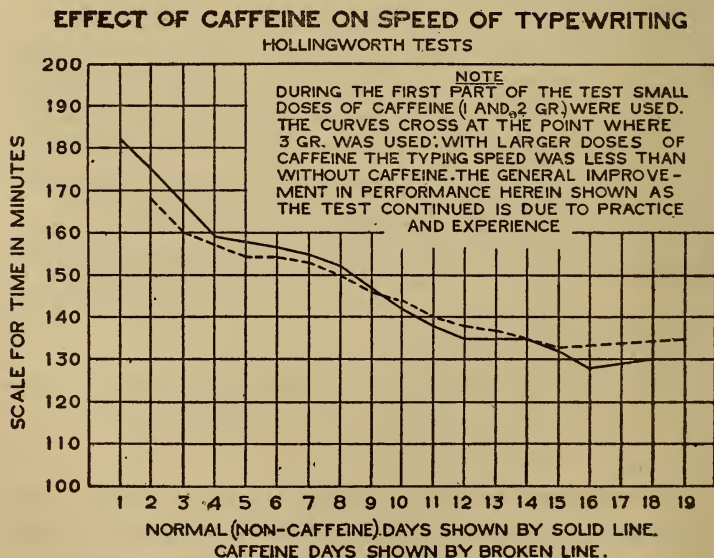


FIG. 22.

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### DOSES OF CAFFEINE

	Normal	1 gr.	2 gr.	3 gr.	4 gr.	5 gr.	6 gr.
Squad 1,	1.019	1.013	1.004	1.008	1.012	1.053	....
Squad 2,	.987	.953	.964	.979	1.000	....	1.028

In the typewriting tests the speed of performance was quickened by small doses of caffeine (1 to 3 gr.) and retarded by larger amounts (4 to 6 gr.)

### *Color Naming Test* (4).

The first of the Perception and Association Tests was designed to measure the speed with which the name or idea can be brought to consciousness upon the sight of an object, which in this case was a colored card. This series of tests showed that there is a clear indication of stimulation from the use of caffeine for the whole range of doses employed. This stimulation is more apparent after the smaller doses than after the larger.

### *Test of Naming Opposites* (5).

This test covered the association of one idea with another specific idea, and as used, a list of 50 adjectives were given to the subject who was required to promptly name aloud a word of opposite meaning, the total time of the test being recorded. The words used in this test were such as:

Loud	Fertile
Slovenly	Wise
Innocent	Masculine
Broad	Beautiful, etc.

The tests showed that the influence of caffeine is stimulating. The amount varies from 15 per cent. absolute stimulation to mere counterbalance of a normal fatigue. The greatest effect resulted from small doses. The magnitude of the caffeine

influence varied inversely with the body weight and was relatively slight when the dose was taken at 10.30 A. M.; somewhat greater when taken with the mid-day lunch and still greater when taken in the middle of the afternoon without food.

*Calculation Test (6).*

This test required the association of an idea with a specific task or situation which called for an appropriate and immediate response. In conducting this test, cards were used containing 50 two-place numbers between 20 and 80, all numbers ending in 0 being omitted. These 50 numbers were in random order and each number occurred but once in a list. The subject was required to take each card and add 17 mentally to each number. The time required to perform the fifty additions correctly was carefully measured. This test showed that there was a most pronounced stimulation following the use of caffeine.

*Discrimination and Choice Reaction (7).*

This test required that the subject press a telegraph key in circuit with an electric buzzer upon the appearance of certain specified colored discs which appeared at random with other colored discs; the time being recorded by a pendulum chronoscope, between the appearance of a certain colored disc and the pressing of the key. This test indicated that small amounts of caffeine tended to produce retardation in discrimination time; this retardation being accompanied by a greater number of false reactions. Larger amounts of caffeine produced, within two hours after the dose, a discrimination so great that the retardation following small doses does not appear.

*Cancellation Test (8).*

This test was intended to cover both attention and discrimination and consisted of crossing out figures on a printed sheet. The general effect of the use of caffeine was stimulation for large doses, but small doses showed retardation. Moreover, the caffeine influence was not in evidence until several hours had elapsed after the administration of the dose.

*Discrimination and Illusion (9).*

The well-known size-weight Illusion Test was employed, 14 cylindrical weights of the same size being used, differing in weight from 15 to 80 grams by increments of 5 grams. Each subject was required to select one of the cylindrical weights supposed to be equal to that of a constant standard block which was several times the size of the weights constituting the series. The use of caffeine had no effect upon the accuracy of judgment displayed by the various subjects.

*Steadiness Test (10).*

This test was designed to record the steadiness with which the individual could hold the outstretched arm, holding horizontally a metal rod of small diameter in a larger hole formed in a brass plate. When the rod moved and touched any part of the brass plate an electric contact was made and the contact recorded automatically. When caffeine was administered at 10:30 A. M. the average contacts per minute for tests conducted at noon, 3:10 P. M. and 5:30 P. M. were:

Normal (no caffeine),	1.46
Caffeine, 1-2 grs.,	2.34
Caffeine, 4-6 grs.,	1.60

When doses of caffeine were given with the lunch at 1 P. M. the average for the two afternoon readings, as compared with the normal control, were:

Normal (no caffeine),	1.40
Caffeine, 1-2 grs.,	1.89
Caffeine, 3-4 grs.,	1.30
Caffeine, 6 grs.,	1.25

When lunch was eaten at 11:45 A. M. and caffeine was given at 1:45 P. M. then the average for the 3:10 P. M. and 5:30 P. M. tests were:

Normal (no caffeine),	2.81
Caffeine, 1-2 grs.,	3.30
Caffeine, 3-4 grs.,	3.03
Caffeine, 6 grs.,	8.20

At 5:30 P. M. the average of two subjects, taking 6 grains of caffeine, showed 12.10 contracts per minute or 4.06 times as much unsteadiness as the ten controls or sugar subjects.

The detrimental effect of large doses of caffeine on steadiness and nerve stability is shown in the tests conducted with a smaller hole in the brass plate, caffeine being given twice per day, just before the 3:10 P. M. and 5:30 P. M. tests:

	Number of Contacts per Minute		
	Noon	3:10 P. M.	5:30 P. M.
No caffeine days,	10.5	12.4	11.4
Syrup days,	9.5	11.5	10.5
Small doses of caffeine			
with syrup,	11.5	10.6	13.0
6 grs. caffeine with syrup,	9.4	18.4	28.0

Commenting on these results, Hollingsworth says, "After 1-4 grains of caffeine, a slight nervousness ensues which is not apparent until several hours after the dose. After 6 grains there is pronounced

unsteadiness which begins to be manifested within an hour or so after the dose, but which is still greater after 3-4 hours. Such unsteadiness as is produced is less clearly shown when the caffeine is taken in the forenoon or at lunch time, than when it is administered in the afternoon, unaccompanied by food. These results are exactly paralleled by the influences of caffeine on the quality and quantity of sleep and suggest an intimate relationship between the measurable tremor produced by caffeine on a given muscle group and the evident nervous excitement that is responsible for the insomnia produced by large doses of the same substance."

*Effect On Sleep (11-12).*

The average normal sleep period of the subjects was 7.62 hours. The effect of the use of caffeine was as follows:

Caffeine Doses,	Number of Hours Sleep.			
	1-2 grs.	3-4 grs.	6 grs.	Average
Morning Dose,	7.46	7.57	7.07	7.37
Lunch Dose,	7.57	7.33	6.40	6.90
Afternoon Dose,	7.38	7.00	6.30	6.88
Average,	7.47	7.30	6.59	7.05

Large doses of caffeine induce marked sleep impairment. The effects are greatest when the dose is taken on an empty stomach or without food substances and when it is taken on successive days. The quality as well as the quantity of sleep is also detrimentally affected.

*General Health. (Hollingsworth Tests)*

In a test of this kind, covering 40 days, the regular régime of life of the subjects and their abstinence from all drugs (except caffeine during tests) tea, coffee, tobacco, chocolate, cocoa, soda-

fountain drinks, alcoholic drinks, would make for health and good spirits. All were compelled to keep regular hours for eating and sleeping and dissipation of every kind was avoided. Notwithstanding these ideal conditions, headaches, poor sleep, irritability, and nervousness were prevalent in subjects taking 4 grains of caffeine or over and dizziness, perspiration, throat-trouble, feverishness, heart thumpings, numbness and stomach pains were experienced by some. These symptoms of deleterious drug action were evidenced in slight women after the administration of 2 or 3 grains of caffeine. The fact that some of the subjects felt badly and experienced headache on control days (days without caffeine) indicates that the drug has a subtle, delayed or accumulative action and, moreover, it also suggests psychological complication. If an average person fed with a capsule containing a drug for several days, experiences distress, the continuance of the capsule, even if it contains sugar, will often tend to produce a reaction of pain; on the reverse side we know that pills or tablets of salt or sugar, possessing no healing virtue, have been credited with marvelous cures, due entirely to the psychological effect of suggestion.

There is a general correlation between sleep-quantity and intensity—and general health. The two principal factors which seem to modify the degree of the caffeine influence are bodily weight and the presence of food in the stomach at the time of the dose. All subjects—men and women—were detrimentally affected by caffeine administered in large doses, and it was not beneficial to any of them at any time. Caffeine increases the capacity for work, but this is a genuine drug effect, and this in-

creased capacity is obtained by the sacrifice of well-being.

The following table gives a general summary of this most interesting and complete series of tests:

SCHEMATIC SUMMARY OF HOLLINGSWORTH CAFFEINE TESTS.

Process	Test No.	Nature of Tests	Primary Effect			Action Time Hours	Duration In Hours
			Small Doses	Medium Doses	Large Doses		
Motor Speed, Co-ordination,	1	Tapping	S	S	S	.75 to 1.5	2 to 4
	2	Three Hole	S	O	R	1 to 1.5	3 to 4
	3	Typewriting					
		(a) speed	S	O	R		
		(b) errors	Less	Less	Less	Results showed only in total days' work	
Association,	4	Color-naming	S	S	S	2 to 2.5	3 to 4
	5	Opposites	S	S	S	2.5 to 3	Next day
	6	Calculation	S	S	S	2.5	Next day
Choice,	7	Discrimination					
		Reaction time	R	O	S	2 to 4	Next day
	8	Cancellation	R	O	S	3 to 5	?
General,	9	Size & weight illusions	O	O	O	None	None
	10	Steadiness	Unsteadiness			1 to 3	3 to 4
	11	Sleep quality	Varies with individuals. Averages less sleep and poorer quality. Varies with individuals. Medium and large doses are positively detrimental.			Varies	Varies
	12	Sleep quantity					
	13	General Health				Varies	Varies

(For further data regarding these tests, see "The Influence of Caffeine on Mental and Motor Efficiency," by H. L. Hollingsworth.)

**General Summing Up of Effects of Caffeine**

Caffeine taken in the form of coffee or tea is apt to be more powerful and harmful than when taken as a pure drug, for both coffee and tea, particularly the latter, contain other ingredients positively deleterious to health. The Hollingsworth tests have demonstrated that caffeine, under certain conditions, improves both the mental and motor processes of an individual, but this is obtained at the sacrifice of nerve stability and general physical well-being. Caffeine, therefore, acts as a true stimulant, i. e., as a whip or goad which lashes or prods the system to greater effort and leaves the pain of the cutting lash and the wound of the goad. Caffeine tends to urge one to the expenditure of effort greater than one's system could normally and habitually withstand. It does not make strength or give energy to meet unusual demands, but it urges the expenditure and dissipation of reserve force. Caffeine, therefore, in harmony with all stimulating drugs is a tyrant forcing its slaves and victims to unnatural efforts. The nervousness, headache and inability to sleep, resulting from coffee, are indicative of the expenditure of normal nerve force, the dissipation of reserve power and resultant nerve or energy poverty. To recuperate, the body must rest and be fed with nourishing, energy-creating and nerve-building foods. Alcohol lessens one's capacity for work, caffeine increases it; alcohol is a narcotic and in sufficient doses produces sleep; whereas, caffeine is a stimulant and makes for wakefulness and activity. Both are poisons and both are injurious to the human body. Alcohol bemuddles the brain, slows it down after a temporary and apparent exhilaration and robs it of its power.

Caffeine lashes the brain to action, forces it beyond its natural power, destroys the speed-governor and ultimately results in complete nerve collapse.

In the "race of life," alcohol tends to act as a heavy dead load, lessening one's power for progress and achievement. It is a veritable millstone of pernicious habit deadening one's natural energy and dragging its victims to earth. Caffeine tends to act as a goad urging one by spur, lash, abuse and excitability to unnatural efforts. It is an unstabilizer, it drives to a "break" and forces its victims "into the air" of physical collapse, nervous prostration and neurasthenia. Irritability, excitability and passion are stages of insanity, and caffeine as well as alcohol claims its victims of diseased and unbalanced mentality.

#### **Effect of Caffeine on Progeny.**

Much has been said and written of the effect of alcoholism on offspring, but no thorough investigations seem to have been made on the effect of the excessive and habitual use of caffeine on progeny. It is very possible that the abuse of the nervous system of parents for many generations will have a most pronounced effect upon the nerves and disposition of the young. The civilized races are becoming more and more nervous because of their unnatural modes of life, and any drug habit that tends to increase this condition of nervous instability or weakened nerve energy is not only unfortunate, but vicious. Biological laws are immutable and operate heartlessly when fundamental and eternal principles are either ignorantly or maliciously ignored.

**Effect of Drugs Varies with Individuals**

The variations in individual susceptibility to tea, coffee and cocoa and the extent of toleration through habitual use are most marked. Any person who permits himself to get into a condition so that he cannot do acceptable work without drugged drinks and, therefore, day after day takes caffeine in quantity in the form of tea and coffee, is a victim of a pernicious drug habit and is drawing upon his reserve forces in a vicious manner and to a deplorable extent. The whip may be appropriate for the lazy, but not for the tired, the over-worked and the undersized horse with the killing heavy load.

It is too much to claim that the use of tea and coffee should be absolutely tabooed. As alcohol can be used at times to advantage, so can the drug caffeine. It is true, however, that the majority of people would be better without either, and all who find themselves strongly stimulated by caffeine should exercise the part of wisdom and limit its use to occasions which can be classified as of an emergency character, when uncommon demands are made upon the endurance of the mind and body and when, for a time, hygienic considerations have to be ignored. If young people, and those in the vigor of maturity, would postpone the formation of the caffeine (tea, coffee, cocoa) habit, they would have one more resource when the pressure of advancing life becomes severe and their tasks seem at times greater than their systems can cope with.

**No Food Value in Coffee and Tea**

Tea and coffee of themselves have absolutely no food value; when mixed with cream, milk or sugar they possess only the food value of such added in-

gredients. In many cases, however, cream and sugar, particularly the former, added to caffeine drinks, result in a more protracted digestive and constitutional disturbance, all of which varies with the individual. The more water we take with our tea, coffee and cocoa the healthier the drink, just as the more water we drink with an alcoholic spirit the healthier the drink. Water is what the system needs and demands, not tea, coffee, cocoa, concocted soft-drinks, soda fountain products, beer, wine, whisky or any form of spirits.

### **Inconsistency of Present Prohibition Tendencies**

The temperance advocate who preaches the prohibition of a poisonous beverage should practice temperance or prohibition consistently. Why select for condemnation or prohibitive legislation, a drink containing about three per cent. of poisonous alcohol, such as beer, which when moderately and occasionally used has, under certain conditions, some nutritive value and never consider a drink made from leaves containing over three per cent. of a deadly drug, injurious aromatic oils, and about five times as much of a powerful, deleterious astringent. More lives have probably been "shrunk up" in the aggregate by excessive tea drinking than have been ruined by pure, mild and well made beer, taken like tea under proper home surroundings. Who can estimate the horrible effects of "soda water" fountains, drug store "drugged" drinks, and bottled soft and so-called harmless drinks, upon the children and youth of this country? Alcoholism is a horrible curse inflicted by human beings upon themselves. It cannot be too severely condemned; but other drinks have lowered the vitality and

virility of mankind and polluted and poisoned the body probably quite as much as alcohol. Is not the saloon the greatest curse of alcoholism, and the cause of the habit of unnecessary, senseless and so-called social drinking? If alcohol were served as a mild solution only with food, at home or in licensed hotels—i. e., travellers' homes—or administered pathologically, would not three-fourths of its crime be eliminated? A concealed bar, serving alcoholic spirits indiscriminately, is as bad as an opium den and should be removed, but "law" should be consistent and based on the whole truth and not on a small part of it, and the dignity and liberty of man and the God-like attributes of the human mind should be respected. Men need to be shown the truth, educated to the knowledge of the full truth and not shackled and robbed of their individuality by hysterical legislation and fanatically conceived and agitated laws; but if prohibition (positively un-American) is to be considered, why not make it affect and cover the drugged drinks of the so-called reformer and alcohol abolitionists? Why should a mild alcoholic drink which tends under ordinary conditions to make one stupid and inefficient be outlawed, while caffeine drinks which excite and drive one onward to the collapse of the nervous system and heart and to a mental break through vicious exhilaration, are tolerated as a "temperance" and, therefore, desirable beverage. Is it not inconsistent to call one poison a National Menace and another a needed National Stimulant? Both can be used pathologically at times with benefit; but both used habitually and to excess are detrimental to the human system, health and happiness. If one is inclined to "reform" the world by attempting the

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impossible task of ridding it of the narcotic alcohol, why not turn the searchlight of unbiased inquiry upon the deleterious effect of caffeine and its allied stimulating drugs, and with the harm caused by the intemperate use of each in this impartial scale of science, it is extremely difficult to foretell which side of the scales would hang low.

### COMPOSITION AND NOURISHMENT OF NON-ALCOHOLIC DRINKS

BEVERAGES	Quantity	Weight grams	Water per cent	Protein Calories	Fat Calories	Carbo-hydrates Calories	Total Calories	Calories per 100 grams
Cocoa,	1 cup	227	.77	37.2	144.4	97.8	279	123
Ingredients:								
1 h. tsp. cocoa,								
1 h. tsp. sugar,								
$\frac{3}{4}$ c. milk								
1 tbsp. cream								
Coffee or Tea,	1 cup	246	.88	11.5	71.1	73.1	156	64
Ingredients:								
$\frac{1}{4}$ c. milk								
1 tbsp. cream								
2 cubes sugar								
Coffee or tea								
Egg Lemonade,	1 large glass	314	.82	27.5	48.8	173.6	250	80
Ingredients:								
1 egg								
2 h. tbsp. sugar								
2 tbsp. lemon juice								
$\frac{3}{4}$ c. water								
Lemonade with white of egg,	1 large glass	297	.84	16.8	.7	173.6	191	64
Ingredients:								
White 1 egg								
2 h. tbsp. sugar								
2 tbsp. lemon juice								
$\frac{3}{4}$ c. water								
Lemonade—plain,	1 glass	264	.83	..	..	173.6	174	66
Ingredients:								
2 h. tbsp. sugar								
2 tbsp. lemon juice								
$\frac{3}{4}$ c. water								
Malted Milk,	1 cup	235	.81	39.8	94.1	86.9	221	94
Ingredients:								
1 h. tbsp. malted milk								
$\frac{7}{8}$ c. milk								

## IV.

### OILS

**T**HERE are a great variety of unctuous, combustible, liquid substances of diverse chemical character not miscible with water which are known as oils, a designation which embraces the fixed or fatty oils, such as olive oil, the soft fats which may be fluid in their country of origin, such as cocoanut oil and palm oil, the odoriferous, ethereal or essential oils, and the fluid, mineral hydrocarbons found in nature or obtained from natural products by destructive distillation. No sharp distinction can be made between fatty oils and fats, but the term "oil" is generally applied to substances of this class which are fluid, due to their large olein content, at a temperature below 70° F.; and the term "fat" covers similar matter which, owing to large stearin and palmitin content, remains solid at higher temperatures. Oils can be divided into two prime classifications, viz.: vegetable and animal, and the latter can be further subdivided into marine-animal and terrestrial-animal oils.

Oils, although possessed of all the characteristics of liquids, and with viscosity which permits some of them to flow very easily, are not used by the human body as beverages to quench the thirst; and pure oils, having no water content (for they are insoluble in water), when edible and taken into the body, must be considered either as "fuel food" or possessing medicinal virtue. There are many vege-

table oils considered edible, and many vegetable and animal fats, which are liquefied at higher temperatures, are used as food. Animal oils, both marine and terrestrial, are generally used for manufacturing, lubricating or fuel purposes, with the exception of Cod Liver oil and its adulterants or substitutes, which are used by man medicinally.

### Vegetable Edible Oils

Vegetable oils are divided into classes designated as Drying, Semi-drying and Non-drying, based on the power of absorbing oxygen on exposure to the air. The following is a list of vegetable oils that are generally classed as edible:

Name of Oil	Type	Yield, Per Cent.
Sunflower	Drying	21-22
Poppy Seed	"	41-50
Soja Bean	Semi-Drying	
Maize; Corn	"	6-10
Beech nut	"	43-45
Kapok	"	30-32
Cotton Seed	"	24-26
Sesame	"	50-57
Brazil nut	"	
Arachis (ground nut)	Non-Drying	43-45
Hazel nut	"	50-60
Olive	"	40-60
Ben	"	35-36
Grape Seed	"	10-20

Edible vegetable oils are highly nutritious, in the sense that they afford as fats to a greater degree than any other kind of food products, the element necessary to the production of heat and energy. The number of calories in one gram of edible oil is 9.3. Stohmann's figures for the heat or food value of certain oils and fats are:

Olive Oil,	9.384	Cal.	per	Gr.
Animal Fat,	9.372	"	"	"
Butter Fat,	9.179	"	"	"
Average,	9.312	"	"	"

When we consider that the food value of protein, sugar or starch is only 4.1 Cal. per Gr. it will be seen that edible oils are two and one quarter times as valuable in the production of heat and energy as our most generally used items of diet, and they are, therefore, concentrated foods.

Wiley says, "The use of edible vegetable oils is also advisable for hygienic purposes. They are readily assimilated and digested, and they produce a physical effect upon the process of digestion which is a matter of importance." Edible oils cannot be very generally used and can never form a very important part of one's diet. They cannot be taken as one would any other form of liquid, and they are not readily usable except in conjunction with other condiments as salad dressing; but as a base for salad dressing, olive oil and the other edible vegetable oils are used most extensively. Edible oils may also at times be used to advantage in lieu of animal fats in cooking, but products that are fried or boiled in oil, notwithstanding what may be said in their favor, are not to be recommended for delicate stomachs or for the average person leading a sedentary life.

Olive oil, because of its relative palatability, flavor, nutritive power and abundance, has been from the earliest historical times and remains today, the most important of all edible oils. By reason of its value and its commanding high price, there are few, if any, substances that have been subjected to such a systematic and extensive adultera-

tion as Olive oil. Nearly all edible vegetable oils have the light amber color and general characteristics of Olive oil and adulterations are very difficult to detect.

In the United States the principal adulteration of Olive oil is with cottonseed oil, which oil, when subjected to the most careful refining processes can be offered at a price probably not greater than 20 per cent. of that of high grade Olive oil. Cottonseed oil adulteration of Olive oil often extends to complete substitution, cottonseed oil being represented as Olive oil, both by the dealer and the label, although it may contain no trace whatever of the oil of Olives. In Europe, Olive oil is also commonly adulterated with sesame and peanut oils, also rapeseed and poppyseed oils. Our Government Chemists report that "small quantities of castor oil, lard oil, fish oil and even a petroleum oil have been found as adulterants in Olive oil."

Olive oil consists almost exclusively of olein and palmitin, and there is but very little, if any, stearin in the highest grade oil. The specific gravity at 60° F. averages .917, the range being from about .912 to .919.

Analyses of ripe and green olives gave the following results:

				Food-value	
	Water	Protein	Fat	Carbohy- drates	in Calories
Ripe Olives,	64.7	1.7	25.9	4.3	1205
Green Olives	58.	1.1	27.6	11.6	1400

The production and refining of cottonseed oil in the United States has grown to be an industry of great magnitude, and it is estimated that about three million barrels of 50 gallons each are pro-

duced per annum in this country; of this amount it has been said that two and a half million barrels are used in some form or other for food purposes. The seed of the cotton plant is very rich in oil and protein. It contains traces of certain poisonous alkaloids, the presence of which renders its indiscriminate use for cattle food dangerous. Wiley says, however, that "In the preparation of oil, no trace of these poisonous substances is found, since they exist solely in the non-fatty tissues of the seed." Cottonseed oil has a high nutritive value and recognized authorities say that "no objection can be made to it from any hygienic or dietetic point of view." This may be true, and some persons may be quite willing to substitute cottonseed oil for pure Olive oil as a base for salad dressing or as a medicinal potion, but if so, they should get the economic benefit of the substitute and not pay an Olive oil price for the much cheaper cottonseed oil. There are, however, very many people who would much prefer to take into their system the pure oily juice of the fruit of the Olive tree and pay a fair price for it, rather than use the oil of cottonseed, even if it could be bought at one-fifth the cost. For cooking purposes cottonseed oil may be a good and, under certain conditions, an agreeable substitute, but, as a base for salad dressing the average user, not to mention the connoisseur, greatly prefers pure Olive oil to any of the doctored substitutes—European and American—with which the market is flooded. Some people who are extensive users of supposedly Olive oil have developed such a depraved "oil taste" that they would be greatly surprised at the flavor and action of the pure cold-pressed "virgin oil" juice and imagine that they

were being imposed upon by some unscrupulous dealer. Very possibly they have used for years a labelled "pure virgin Olive oil," flavored, doctored and adulterated which contains little, if any, Olive oil, and if any Olive oil is present, it is possibly only the oil of the lowest grade obtained from the heated pomace of the fruit.

In the making of salad dressings, vinegar, which is a sour liquid obtained by fermentation of wine, cider, malt, etc., is almost universally used. In America we use cider vinegar; in France wine vinegar and in Great Britain malt vinegar are common. Even vinegar is subjected to many kinds of substitutes, imitations and adulterations, and much distilled vinegar, made by the acetification of dilute alcohol, and probably colored with caramel, is on the market. Vinegar is not a healthful liquid put into the average stomach, and irritating condiments, such as pepper, are much better out of the body than in. A healthful palatable salad dressing can be made with pure Olive oil and lemon juice, the latter being an excellent substitute for vinegar. Olive oil has medicinal virtue as an emollient. It is used as a demulcent to diminish hydrochloric acid secretion in the stomach and to allay irritation. Under certain conditions it acts as a laxative, but modern research has proven that it does not materially affect, if at all, the secretion of the bile, and it tends to prolong the emptying time of the stomach.

### **Animal Edible Oils**

The only animal oil extensively used by man as a food or medicinally is a "Liver Oil" of the marine group, viz.: Cod Liver Oil, which has long been

used by the fishermen of the North Sea primarily as a remedy in children's diseases and during the last 50 years has become quite generally used. Taken repeatedly, Cod Liver Oil increases the weight and strength and tends to improve the general physical condition. The same effects are obtained in healthy persons by the use of good food and fats, but Cod Liver Oil apparently can be digested by delicate persons who are unable to digest ordinary animal fats. Its effects are obviously those of an easily assimilable food; it is not a drug, has no place in pharmacology and should be classed as a liquid food. Cod Liver Oil has always been supposed to have some wonderful and peculiar medicinal property. It contains faint traces of iodine, bromine and, at times, phosphorus, and these ingredients have been believed to have a pronounced pathological effect upon the human system, but we now know that they are present in far too small quantities to be important. Cholesterin has been suggested as the curative agent, but it is present in smaller quantities in Cod Liver Oil than in many other foods. Bastedo says, "The value of Cod Liver Oil in sickness seems to be entirely dependent upon its digestibility as a fat. It is nothing but a readily digestible fat food, and has no special medicinal virtues." Cushny, referring to the relative digestibility of Cod Liver Oil and ordinary fats, says, "It is generally believed to differ from ordinary fats in being more readily assimilable, but the explanations of this fact are by no means agreed upon, for though it is often said to be more rapidly absorbed from the intestines, there is little reliable evidence that such is the case. The chief argument brought forward in its support is

that Cod Liver Oil forms an emulsion in the test tube more rapidly than other oils. It is undoubtedly well borne by the stomach, but it has not been often compared with other oils in regard to this point, and it is still impossible to state that other oils administered with the same care as Cod Liver Oil are not equally successful remedies." On the whole, Cod Liver Oil has not been shown to have any action apart from that of an easily digested liquid "fat" food and its superiority to some other fats and oils has not been satisfactorily established, nevertheless, the number of chemical compounds occurring in Cod Liver Oil is much greater than that which occurs in ordinary oils.

Cod Liver Oil has a specific gravity of .922, a bland fishy taste and a fishy odor. The oil is nauseating to many people, hence it is customary to administer it with the extract of malt or in the form of a sweetened and flavored emulsion. Experiments indicate that emulsified oils are more readily absorbable than the unemulsified, especially by persons of poor nutrition, and it has been noted clinically that the emulsion is easier to take and is better borne by the stomach than the pure oil.

Cod Liver Oil is used in chronic wasting diseases, such as tuberculosis, scrofula, rickets, etc., but seems only to have the virtue of an easily digested high fuel-value food. In all forms of malnutrition and delicacy in children, it is largely used and undoubtedly tends to increase weight, but care must be taken that it does not disturb the digestion, as it is a rich, concentrated, fatty food and can only be used within clearly defined limits.

Cod Liver Oil has been subjected to many forms of adulteration, the most extensive consisting of the

admixture of fish liver oils of lower quality or the use of blubber oil. Seal and whale oils, Japan Fish oil and practically all other fish oils which are of a character that will not materially disguise the properties of Cod Liver Oil, have been used. The fish oils of commerce and industry are the sardine, salmon, menhaden and herring, generally used for currying leather. Liver oils, such as Cod Liver and Shark Liver, are used for the same purpose. Blubber oils from the seal and the whale are used for fuel and currying leather, and the latter is used for soap making and fibre dressing. The oils from the Dolphin and Porpoise are used for lubricating delicate machinery. Of the terrestrial animal oils, such as sheep's foot, horse's foot, and neat's food, all are used for lubricating or leather dressing; therefore, of the entire range of fish and animal oils, Cod Liver Oil is the only one that experience has branded as edible, and this can be used only sparingly as a food as one would other vegetable and animal fats.

### **Medicinal Mineral Oils**

These mineral oils which have been used quite extensively during the past few years, although liquid, cannot be considered as a beverage and, moreover, they possess no food value. These oils are really liquid paraffin or petroleum oil, but are also known as liquid vaseline, liquid albolene, liquid petrolatum and Russian mineral oil, the latter being quite popular because of the wonderful medicinal virtue attributed to it. Lane first suggested such oils to be taken internally for chronic intestinal stasis with auto-intoxication. They are not ab-

sorbed from the alimentary tract and are, therefore, but intestinal lubricants tending to soften and increase the bulk of the feces and facilitate their passage through the intestines and colon to the rectum. Such oils, taken in moderation, have but little effect upon the stomach, but like all other oils, they tend to retard stomach emptying and gastric digestion. Mineral oils act mechanically and not chemically, and do not excite any pronounced laxative action. Whereas, superior to cathartic drugs, the continued internal use of such unnatural fluids is not to be recommended. Water enemas, or preferably internal baths, using sterilized water, are less harmful to the system than non-assimilable mineral oils; these oils enter the stomach and traverse the entire digestive tract as a foreign undesirable body which the system is naturally desirous of eliminating. Proper food, selected and eaten with intelligence, will obviate the necessity of any mechanical or chemical means to facilitate the natural bodily functions, and the popular and persistent use of mineral oils, whereas, not as harmful as the use of drugs and poisons, is nevertheless a fad of certain branches of the medical profession, and is advocated to lessen the evils of faulty living. It would be far better to devote one's energies to the elimination of the "cause," instead of loading one's system with undesirable foreign matter, in an attempt to modify "effects." Sane eating and drinking, both as regards quantity, quality and time periods, sane living with mental and physical harmony established with nature and one's environment, will make the use of mineral oils unnecessary and undesirable.

## COMPOSITION AND FOOD VALUE OF CONDIMENTS

	Quantity	Weight grams	Water per cent.	Protein Calories	Fats Calories	Carbohydrates Calories	Total Calories	Calories per 100 grams
Olive Oil	1 tbsp.	13	...	...	120.9	....	121	930
Mayonnaise dressing	1 tbsp.	21	.04	1.1	185.3	.2	187	890
Ingredients:								
2 eggs								
2 c. olive oil								
1 tsp. vinegar, or								
1 tsp. lemon juice								
Salt, pepper, mustard								
Hollandaise sauce	2 tbsp.	40	.46	7.6	161.5	1.3	170	425
Ingredients:								
1/2 c. butter								
Yolks 2 eggs								
1 tsp. lemon juice								
Salt, cayenne pepper								
French dressing								
Ingredients:	1 dsp.	11	.36	...	74.4	....	74	673
4 tsp. olive oil								
1 tsp. vinegar								
1/4 tsp. salt								
Pepper								
Catsup—tomato	1 tbsp.	20	.82	1.2	.4	10.1	12	58

## V.

### FRUIT JUICES

**F**RUITS were doubtless among the earliest foods of man and the name has been derived from the Latin "fructor" meaning "to enjoy." The designation is generally applied to such seed envelopes of plants as are edible and juicy. Fruits may be divided into the orchard class, growing on trees, the berry class, growing on shrubs and bushes, and the vine class growing on creepers, whereas another classification could be made between the wild and the cultivated. The general characteristics of fruits are determined by their color, flavor, size, odor, relative solidity, water and juice content and nutritive properties. They are composed very largely of water and the solid matter consists of the usual cellulose of vegetable bodies, sugars, gums, organic acids and mineral matter. Fruits are all succulent and when subjected to pressure, yield a refreshing juice which contains the principal portion of their dietetic constituents, viz.: sugars and acids. Nature has so arranged that in the hottest regions of earth the most juicy fruits are to be found, the thirst-quenching properties of fruit being due not only to their large water content, but also to the organic acids and salts contained therein. The fine aroma of fruit is caused by ethereal oils which are principally contained in the cells of the skins.

Wiley has prepared the following table to ex-

press the average content of sugar and acids in the common fruits:

Fruit	Sugar per cent.	Acid per cent.
Apples, Rhode Island	10.95	0.70
“ Winesap	11.95	0.50
“ Northern Spy	11.80	0.70
Apricots	11.01	1.15
Bananas	20.28	0.30
Blackberries	5.78	0.77
Cranberries	1.52	2.34
Grapes	7.9 to 26.4	0.59
Lemons	0.37	5.39
Oranges	5.65	1.35
Peaches	7.88	0.56
Pears	9.11	0.19
Pineapples	11.50	0.60
Plums	14.71	0.77
Prunes	16.11	0.32
Raspberries	5.33	1.48
Strawberries	6.24	1.10

In addition to the sugar content here given, other carbohydrates are present in small quantities.

In the above table the acidity is determined as malic acid in apples, blackberries and strawberries, in which the predominating acid is malic. In cranberries one of the acids is benzoic, amounting sometimes to as much as 0.05 per cent.; in grapes it is tartaric, and in lemons and oranges citric. In the other fruits, where the character of the organic acid is not distinctly of one kind, the total organic acid has been estimated as sulphuric acid, not meaning, of course, that the acids are present in that form, but merely that their quantity was measured in terms of sulphuric acid.

In order to obtain fruit with a high content of sugar and only very little acid, it must be left on the tree until absolutely ripe. The later it is gathered, moreover, the stronger will be the perfume. Baldwin apples, for instance, when green showed 8.03 per cent. of sugar and when very ripe 14.07 per cent.

The following table gives the water content, composition and food or fuel value of various fruits:

## COMPOSITION AND NOURISHMENT OF FRUITS

	Water	Protein	Fat	Carbo- hydrates	Ash	Food Value Calories
Fresh Fruit, Berries, Etc.	per cent.	per cent.	per cent.	per cent.	per cent.	per pound
Apples — Edible	84.6	.4	.5	14.2	.3	290
Apricots	85.0	1.1	....	13.4	.5	270
Bananas — Edible	75.3	1.3	.6	22.0	.8	460
Blackberries	86.3	1.3	1.0	10.9	.5	270
Cherries	76.8	.9	.8	15.9	.6	345
Cranberries	88.9	.4	.6	9.9	.2	215
Fresh Figs	79.1	1.5	....	18.8	.6	380
Grapes	58.0	1.0	1.2	14.4	.4	335
Huckleberries	81.9	.6	.6	16.6	.3	345
Lemons — Edible	89.3	1.0	.7	8.5	.5	205
Muskmelons—Edible	89.5	.6	....	9.3	.6	185
Nectarines	82.9	.6	....	15.9	.6	305
Oranges — Edible	86.9	.8	.2	11.6	.5	240
Peaches — Edible	89.4	.7	.1	9.4	.4	190
Pears — Edible	84.4	.6	.5	14.1	.4	295
Pineapple	89.3	.4	.3	9.7	.3	200
Plums — Edible	78.4	1.0	....	20.1	.5	395
Pomegranates	76.8	1.5	1.6	19.5	.6	460
Fresh Prunes	79.6	.9	....	18.9	.6	370
Red Raspberries	85.8	1.0	....	12.6	.6	255
Raspberry Juice	49.3	.5	....	49.9	.3	935
Strawberries	90.4	1.0	.6	7.4	.6	180
Watermelons						
—Edible	92.4	.4	.2	6.7	.3	140

There are people who do not care to drink water, they do not like it and will not take it unless it is flavored, sweetened or otherwise treated and made more palatable and appealing to them. This is a most unfortunate and serious condition, and such people pamper their pernicious and unnatural sense

of taste by the use of drugged drinks, sickly, syrupy concoctions or poisoned decoctions, brews and infusions. Health is not considered, and well-being is sacrificed at the altar of a perverted luxurious appetite, the product of an artificial existence. Fortunately, fruit juices with or without the addition of water, appeal to many of this class, for fruit juices are palatable, refreshing and thirst-quenching drinks and, moreover, when properly selected and used, are most healthful and invigorating. They also have the advantage, even when taken in large quantities, of seldom becoming injurious to any serious extent, and this cannot be said of any other popular drinks with the exception of nature's own beverage—water. Fruit juices have a certain curative action in the body because of the organic acid and nutritive salts contained therein, and they quench the thirst more satisfactorily than almost any other liquid.

Koenig has prepared the following table to show the analysis of certain fruit juices:

CONTENT IN 100 c. c. OF JUICE

Fruit Juices	Sugar Gr.	Acids Gr.	Tannins precipitated by		Potash Gr.	Phos- phoric Acid Gr.
			Alkalines Gr.	Ash Gr.		
Apple	12.54	0.321	0.115	0.44	0.209	0.019
Cherry	12.81	0.753	0.088	0.45	0.097	0.021
Strawberry	5.33	1.040	Pectin 0.560	0.64	0.097	0.026
Raspberry	5.33	1.846	Pectin 0.960	0.50	0.086	0.032
Huckleberry	6.27	1.130	....	0.29	....	....
Gooseberry	6.12	1.650	0.061	0.27	....	....
Peach	3.85	0.684	Pectin 0.760	0.47	0.076	0.046

**Effect of Fruit Juices on the System**

[Dr. Lorand says that in fevers, fruit juices are very beneficial, as the nourishment to be obtained from some of them may be in the only form that can be tolerated. Fruit juices "have a thinning effect upon the blood, thus diminishing its viscosity and are consequently an excellent drink for arteriosclerotics." They also have stimulating action upon the bowels; the uric acid eliminating and alkalizing properties of certain fruit juices are great and their use is beneficial in gout. Lorand advocates the use of huckleberry juice for chronic intestinal catarrh with diarrhoea. Fruit juices favorably affect diureses; some juices, such as apples and bilberries, are not well tolerated by persons suffering with hyperacidity of the stomach; for diabetes, fruit juices low in sugar are recommended.] The juice of apples may be used by the average person as an agreeable sort of "apple tea." According to Monteuis, this is made by cutting a large apple with the skin into about eight pieces, and pouring over it a pint of hot water; it is then left on the edge of the fire for about two hours. Two or three slices of orange or lemon are added with 5 or 6 pieces of domino sugar. It is to be served hot, thus giving besides the beneficial juice, the full aroma of the apple.

There is probably no country in the world where so many different kinds of fruit can be grown with success and advantage to the native as in the United States. Ours is a country of all climates and all degrees of altitude and humidity. Apples particularly thrive in the Northern portion, and juicy fruits of the citrus family in the South lands. The orange, lemon, lime and grape-fruit (shaddock)

are all cultivated forms of the genus citrus. Apples, a comparatively solid fruit, yield liberal quantities of juice in the press, which can be used fresh or be made into apple wine, cider or vinegar. The juice from any of the fruits of the citrus family is readily separated from the pulp. Oranges are the sweetest and most palatable fruit of this class; at times they contain as high as 10 per cent. of sugar. Lemons are more acid, the analyses of 22 different samples of California lemons showing an average of 2.33 per cent. of sugar and 5.26 per cent. of acid—principally citric acid—about four times as much acid as the average orange. Limes are more acid than lemons and their juice is sold throughout the world for beverage and medicinal purposes. The lime may be popularly regarded as a very sour small lemon. Wiley says, "Unfortunately lime juice is offered on the market often in entirely spurious forms, that is, a mixture made up with flavoring of an acid character resembling that of the natural juice. It is also frequently adulterated by the addition of preservatives. Among these, sulphurous and salicylic acids are perhaps the most frequent. Lime juice can be perfectly preserved by sterilization and there is no necessity for the use of preservatives therein." Lemon or lime juice is used on shipboard to prevent scurvy, which is a disease characterized by livid spots (due to extravasation of blood), spongy gums and bleeding from almost all the mucous membranes. It is occasioned by confinement and innutritious food, but particularly by a lack of fresh vegetable food. The British Merchant Shipping Act of 1867 requires every British ship going to other countries, where lemon or lime juice cannot be obtained, to

take a sufficient quantity of such fruit juices with them to give one ounce to every member of the crew per day. Hence British sailors are popularly called "Lime juicers." Grape fruit contains about 87 per cent. of water, 9.5 per cent. sugar and 2.7 per cent. acids (as citric). It possesses properties which can be considered as a cross between the lemon and the orange, being more acid than the orange and sweeter than the lemon. It has been said that nature made fruits "full of taste" so as to seduce our palates. They contain little nourishment and cannot be considered as a prime food, except by those leading an indolent life in the tropics. The value of fruits lies chiefly in their juices, and while some possess digestive properties, all act as depurating agents. Dr. Moras has said that "All people, young or old, fat or thin, bilious or gouty, anemic or plethoric can take the juices of apples and oranges with benefit. Thin or anemic individuals should, as a rule, avoid lemon juice and favor grape juice, whereas gouty, fat or full-blooded persons should favor lemon and lime juices. The most generally useful and wholesome fruit juice is that of the orange." [Moras also recommends the juices of apples, lemons, limes and grapes, the latter two of which are quite generally extracted and preserved and can be procured "in nearly their natural state, so that they retain much of their remedial or beneficial properties."] Fruits or fruit juices should not be taken with other foods. They are better before a meal than as dessert, but they are much more beneficial if served between meals or taken a full hour before meals. A glass of an excellent bracer and is almost always beneficial orange juice on arising in the morning is generally

to the system if taken when the stomach is empty. Some people need the "woody" fibers of vegetables and fruit to give their digestive tract a reasonable "mass" to operate with, but the average person is benefited far greater with suitable fruit juices taken as a liquid to supply the water demands of the body and, in addition, act to tone up the system, give some nourishment, invigorate and add strength to the cleansing power of water. Pineapple juice taken properly improves the tone of the digestive system. Moras advises the use of pineapple juice and says, "Irrational as it may seem, take it only between meals, because every 'lift' that you give your stomach-juice in the way of 'extra' digestive ferments, the more it learns to expect and to depend on that 'lift'—as your bowels do from taking laxatives or cathartics or injections. Take pineapples between meals, or make a whole lunch on them." Such fruits as bananas are food, and nourishing rather than fruity, juicy and thirst-quenching. Such fruits should be eaten as one would bread or other starchy food for they are, in fact, when imperfectly ripened chiefly composed of starch. Melons should be treated like juicy fruit and eaten as a first course or between meals with no other food and never at the end of a meal.

### **Fruit Juices Adaptable to Tropical Consumption**

Eugene Christian says that the over-consumption of very acid fruits is one of the fundamental errors of nutrition in the Northern countries. "In the tropics, where the pores of the skin are constantly kept open by superficial heat, the body can eliminate and volatilize a great quantity of poison. In the tropics, acids are necessary as germicidal fluids,

but in Northern countries such articles as grape fruit, lemons, limes, pineapples, apricots and all highly acidulous fruits should be avoided save, perhaps, in exceedingly warm weather. Taken at other times, the tendency is to increase the total acid content of the stomach and to ferment other foods. Citrus fruits often become one of the secondary causes of superacidity and fermentation, especially when eaten with meals, the citrus acid partaking of the chemistry of hydrochloric acid. When citrus fruits are taken between meals the residue of acid left in the stomach frequently sours and ferments the next meal." Citrus fruits have been planted by nature in Southern and semi-tropical countries; in such lands they serve as a valuable source of food to peoples thinly clad and exposed to the sun's rays leading a more or less inactive, sluggish life. As a general rule, nature supplies the proper food in each geographical setting for the sustenance of animal life therein and, therefore, citrus fruits in the South lands seem proper, and temperance or abstinence in regard to the use of such fruits for people in the North lands would seem to be the part of wisdom, except under atmospheric and thermal conditions resembling those of semi-tropical lands. Christian's statements are somewhat extreme, however, for the juice of the sweeter citrus fruits taken in moderation generally prove exceptionally beneficial not only to Northern adults, but the juice of the sweet orange diluted has been demonstrated to be very healthful for very young children. The more acid lemons and limes can be used medicinally to great advantage; lemon juice is a healthful and pleasing substitute for vinegar, and sliced lemon can be used to good advantage in lieu of milk, in tea—hot or cold.

**Fruit Juice Adulteration**

Fruit syrups are not fruit juices and most *treated* fruits are artificially changed into "sweets" or "confections." The valuable constituents of fruits are the natural juices and any process that seeks to change the natural juice, add sugar or affect the original characteristics and acid properties, should be looked upon with pronounced disfavor. The juices of fruits mixed with sugar are articles of commerce known as fruit syrups. If honestly made, sterilized or properly pasteurized and correctly handled, they are of use for flavoring drinks such as are served at "Soda Fountains," but they are fruit juices no more. Fruit syrups are extensively and unnecessarily adulterated. The principal adulteration is the omission of the pasteurization process and the substitution of Benzoic or Salicylic acid or their compounds, which are injurious to health and have a deleterious effect upon the system. Imitation fruit syrups by synthetic products are very generally used to-day. Wiley says, "The flavors which give to fruits their character and aroma are chemical compounds produced by nature and are chiefly of the nature of a volatile oil or compound ether. Of these flavors, the compound ethers especially are readily produced by purely synthetic processes. It is possible, therefore, for the chemist to make an approximate imitation of the natural fruit flavor." Wiley also says with emphasis that imitation fruit syrups should never be used except the consumer is notified of the chance he is taking with an artificially prepared article and they should never be used under any circumstances when they contain an ingredient known to be prejudicial to health. Dr. Wiley in this case is too con-

servative, for all fake fruit juices should be outlawed and legislation passed requiring honest and "pure food" substances, for all artificial substitutes lack the properties of nature's creations and all offer a most extensive and profitable field for the unscrupulous and avaricious manufacturer to perform in, to the detriment of an innocent consuming public. The comprehensive use of fruit juice substitutes and adulterants in the United States is an outrage perpetrated on a long suffering public, not only by manufacturers and drug store "fakers" but by grasping and so-called efficient trained servants of our hotels, steamships, trains and institutions. If a traveller or guest in any establishment other than the home, desires pure, fresh, unadulterated orange or lemon juice, the only sure way of obtaining it is to order the fruit and squeeze the juice out himself. Drug stores are generally even worse, if such be possible, and in many, the only oranges or lemons at the soda fountain are for exhibit, and the orangeade and lemonade are positive strangers to the real fruit. Fruit juices without added sugar, are healthful and beneficial; fruit syrups are deleterious to any constitution and will upset digestion; if synthetically concocted with chemicals and made rich in sugar substitutes such as saccharin, they take a prominent place in the van of the list of beverages injurious to health and they should be placarded to clearly show an ignorant, indifferent or thoughtless public exactly what they are.

## VI.

### SOUPS AND EXTRACTS

**S**OUP is a liquid food, usually made by boiling meat or vegetables, or both, in water—seasoned or flavored. Soups are used at the beginning of a meal, at mid-day or evening, and as a rule they do not have much nutritive value. A cup of hot soup served as the first course of a dinner has been called by enthusiasts a “non-alcoholic cocktail.” Under certain conditions a well made soup may perform some useful function, since the introduction of a slightly nutritive hot liquid with condimental properties into the stomach at the beginning of the meal, may tend to stimulate and spur onward the secretive glands of the stomach walls to greater activity and thus promote digestion. “Soup,” it has been well said, however, “should be regarded pre-eminently as a condiment and not as a nutritive substance.” The following table of the water content, composition and food value of various kinds of soup may be of interest:

#### COMPOSITION AND NOURISHMENT OF SOUPS

Soups	Water Per Cent.	Protein Per Cent.	Fat Per Cent.	Carbo-hy- drates Per Cent.	Ash Per Cent.	Fuel Value Calories Per Pound
(A) <i>Home Made</i>						
Beef	92.9	4.4	.4	1.1	1.2	120
Bean	84.3	3.2	1.4	9.4	1.7	295
Chicken	84.3	10.5	.8	2.4	2.0	275
Clam Chowder	88.7	1.8	.8	6.7	2.0	195

(B) *Canned, as purchased*

Cream of Asparagus	87.4	2.5	3.2	5.5	1.4	285
Bouillon	96.6	2.2	.1	.2	.9	50
Cream of Celery	88.6	2.1	2.8	5.0	1.5	250
Chicken Gumbo	89.2	3.8	.9	4.7	1.4	195
Chicken	93.8	3.6	.1	1.5	1.0	100
Consomme	96.0	2.5	..	.4	1.1	55
Cream of Corn	86.8	2.5	1.9	7.8	1.0	270
Julienne	95.9	2.7	..	.5	.9	60
Mock Turtle	89.8	5.2	.9	2.8	1.3	185
Mulligatawny	89.3	3.7	.1	5.7	1.2	180
Oxtail	88.8	4.0	1.3	4.3	1.6	210
Pea	86.9	3.6	.7	7.6	1.2	235
Cream of Green Pea	87.7	2.6	2.7	5.7	1.3	270
Tomato	90.0	1.8	1.1	5.6	1.5	185
Green Turtle	86.6	6.1	1.9	3.9	1.5	265
Vegetable	95.7	2.9	..	.5	.9	65

In the making of soup stock, the base of the material as a rule is that part of the meat and bone that is soluble in hot water and such soup stock usually contains over 95 per cent. of water and less than 5 per cent. of nutritive matter. Many of the clear soups contain very much less nutrient—sometimes as low as one per cent. The number of soups that can be made from soup stock is practically unlimited. Wiley analyzed a pea soup and a potato soup and obtained the followed results:

	Pea Soup Per cent.	Potato Soup Per cent.
Water,	88.26	90.96
Protein	3.38	1.37
Fat,	0.95	1.53
Ash,	1.13	.99
Starch and other Carbohydrates,	6.30	5.13

Beef extract is only a soup, or a soup stock especially prepared from beef. It is said that it requires about 34 pounds of meat to yield one pound of concentrated extract and the extract can be diluted for consumption so as to make from 6 to 7 gallons of what is termed Beef Tea. "The composition of the ordinary beef extract of commerce shows that it contains from 15 to 20 per cent. of moisture, from 17 to 23 per cent. of ash and from 50 to 60 per cent. of meat bases, i. e., the soluble nitrogenous contents of meat." A comparison of the dry substances compared with the dry substances of meat is given by Wiley as follows:

	Protein	Meat Bases	Ash and Mineral Matter
	Per cent.	Per cent.	Per cent.
Extract,	49.7	25.6	24.7
Meat,	86.7	7.8	5.3

The extract is therefore essentially different in its composition from dry meat and has added to it a large quantity of meat fibre or the meat rendered soluble by some kind of treatment. It contains only a relatively small part of the nutritive matter of the meat and its chief value lies in the ease and speed with which it can be handled and become absorbed into the circulation; it is, therefore, of value for invalids, but in the popular mind the nutritious properties of meat extracts are grossly exaggerated. It has been fittingly said, "They may be useful as stimulants or as condimental substances, or as a means of speedily introducing a soluble nutrient in the case of disease, where it is extremely important that even small amounts of nutritious material should enter the body." Beef juice refers solely to the liquid naturally remaining

in the fresh meat after its proper preparation for consumption, i. e., after the withdrawal of the blood and the proper cooling and storing of the flesh.

Wiley gives the following comparison between the composition of beef juice pressed from different parts of meat which had been previously heated externally, and beef extract:

	Beef Juice	Beef Extract
Water,	90.65	21.66
Ash,	1.36	20.46
Salt,	.15	5.47
Phosphoric Acid,	.36	4.55
Fat,	.19	.50
Acid (as Lactic)	.15	8.42
Nitrogen (total)	1.15	7.66

Attempts have been made to put soluble meats on the market especially for invalids and people suffering with disordered digestion. Robert Hutchinson gives the composition of such a preparation as follows:

Water,	67.21 per cent.
Fat,	5.93 " "
Albumen,	11.00 " "
Peptone,	6.51 " "
Meat Extract,	7.55 " "
Ash and Salt,	1.74 " "

Beef tea is in all essential particulars nothing more than a rich unfiltered soup stock and it has approximately the following composition:

Water,	88.00 per cent.
Meat Bases,	3.50 " "
Protein—Soluble and flocculated,	8.00 " "
Ash and Salt,	1.50 " "

Dr. Moras says, "Soups, broths and beef teas as almost universally made, are infusions of the refuse which the animal's blood and tissues happened to retain at the time of its death, but people deceive themselves (by flavoring or seasoning the water or fluid in which said refuse is dissolved) into believing that they are imbibing the substance and essence of the 'nutritives' instead of the substance and essence of the 'excrementitions.'" He adds that fresh vegetable soups eaten with the vegetables have some merit, but beef teas, extracts and bouillon are only good "for bacterial cultures—feeding and raising microbes." Whereas Moras is somewhat extreme, the prime thought is correct. Soup is water with some but very little nourishment, derived from meats or vegetables, or both. The seasoning is stimulating, and it may prove irritating to a sensitive stomach and as a regular item of diet, harmful to the average stomach. The ingredient in soup that is not only harmless but generally beneficial, is the hot water, and if the gastric juice needs stimulating encouragement, probably the hot water in the soup will accomplish the results desired. The use of irritating condiments, relishes, seasoning and spices is most undesirable. The food value of soup is negligible, but under certain conditions the hot water may have virtue, stimulate the flow and dilute the gastric juices, possibly tend to prevent hyperacidity and fermentation, aid digestion by removing causes of irritation and function with other water, taken as liquid throughout the meal or in the food, to promote the purity and circulation of the blood. For many years it was held that no water should be taken with meals. The food for the human body should carry from 65 to 80 per cent.

of moisture and this necessitates some water drinking during meals—not while eating, i. e., while food is in the mouth, but nevertheless during meals. In the majority of cases the gastric juice of the stomach is too strong, and water in the proper amount taken before and after portions of food, is beneficial in maintaining the proper strength of the digestive fluid, as well as in maintaining the needed aqueous equilibrium of the body.

## VII

### ALCOHOL

**A**LCOHOL is not, as is generally supposed, a true stimulant, but has a pronounced narcotic, sedative or deadening effect and must, therefore, be classed as a narcotic and heart-depressant, increasing the rate but not the force of the pulse. Alcohol causes depression of the nerve centers controlling the blood vessels and large doses cause paralysis of these nerves and of the heart. A narcotic is usually classified as a drug which allays morbid susceptibility, relieves pain and tends to produce sleep but which in poisonous doses causes coma, convulsions and ultimately death. Although alcohol has, at first, an apparent stimulating effect, it cannot be a stimulant, for it does not produce an increase of vital energy and vigorous strength. It excites, inhibits and irritates rather than stimulates, and like a true irritant, the ultimate effect of its use in quantity is depression or even paralysis. The term narcotic is derived from words meaning "to benumb" or "to produce a state of torpor." Narcotics depress the central nervous system. They can be divided into four classes:

- General anesthetics, such as ether or chloroform,
- Intoxicants, such as alcohol,
- Hypnotics, such as opium and bromides,
- Antihysteretic or aromatic carminative drugs, used to lessen a state of nervous instability.

It is extremely difficult to draw a hard and fast line between stimulants and narcotics, or between stimulants, depressants, irritants and paralyzing agents. In many cases the action and effect of a drug vary with the quantity used and the time factor. We know, however, that alcohol is a prime intoxicant, that it seems when first taken to act as a stimulant, but it quickly gives the reaction of a narcotic; it is a powerful irritant and at a later stage may act as an hypnotic; it is a powerful poison, and "drunkenness" is but a cumulative production of paralysis of various parts of the nervous system. An English authority has said that "tea sots" are well known to be affected with palpitation and irregularity of the heart as well as with more or less sleeplessness, mental irritability and muscular tremors, which in some culminate in paralysis, while positive intoxication has been known to be the result of the excessive use of strong tea. "In short, from tea to haschisch, we have, through hops, alcohol, tobacco and opium, a sort of graduated scale of intoxicants which excite in small doses and narcotize in larger, the narcotic dose having no stimulating properties whatever, and only appearing to possess them from the fact that the agent can be but gradually taken up by the blood, and the system thus comes primarily under the influence of a 'stimulant' dose. In certain circumstances, and with certain agents—as in the production of chloroform narcosis—this precursory stage is capable of being much abbreviated, if not altogether annihilated; while with other agents—as tea—the narcotic stage is by no means as readily produced." Fisher and Fisk in their admirable book "How to Live," referring to the effect of alcohol, say that,

"It is now conceded that alcohol is not a real brain stimulant but acts by narrowing the field of consciousness. By gradually overcoming the higher brain elements, the activities of the lower ones are released, hence the so-called stimulation, and the lack of judgment and common sense often shown by those even slightly under the influence of alcohol. The man who wakes up under alcohol is really going to sleep, as far as his judgment and reason are concerned."

Alcohol gives a false impression of its action. It does not give great strength but it gives a temporary feeling of unusual strength through paralysis of the sense of fatigue. Sir W. Broadbent has said: "A falsehood which dies hard is the idea that stimulants of whatever kind actually give strength and are necessary for the maintenance of health and vigor. Such is not the case, and the well-worn comparison that they are the whip and spur and not the corn and grass is strictly accurate. Anything accomplished under the influence of stimulants is done at the expense of blood and tissue, and if frequently repeated, at the expense of the constitution." A stimulated belief permits one who has taken a moderate dose of alcohol to do great muscular work for a few seconds, but the strength is assumed; it is false, not real, and endurance becomes woefully weak. Those who employ it in excess are in danger of acquiring an alcoholic thirst or habit toward which the body possesses no effective counter-acting regulation or feeling of satiety. Alcohol is a fuel, and unlike caffeine and similar drugs, it may be termed a "food"; although under certain conditions it may function as a true food, it has aptly been said that it should be avoided

as a food unless administered pathologically. "It is good to burn in a stove but not in the human body."

Bowers has said that "Alcohol is a poison which can be considered a food, provided one carefully avoids using it," and Atwater in an address delivered in Paris said, "Alcohol is a food, within very restricted limits; likewise arsenic, belladonna and other poisons contain nutritive elements, and can, equally with alcohol, be called foods." Dr. Fisher, Director of the New York Hygiene and Life Extension Institute, commenting upon food values said, "What about alcohol? This lecture is about foods, not about narcotics; so we will place alcohol where it belongs—on the drug shelf. You can get the equivalent of its vaunted energy and so-called food value without any of its poison value out of a little sugar and water."

Alcohol is of great medicinal value as a solvent. In strength of about ten per cent. and upwards it is an antiseptic. Applied externally it is of value because of its rapid evaporation, refrigerant and anhydrotic action, and mixed with other substances its field of usefulness, for external medicinal application, is very great. Taken internally in small doses and in sufficient dilution, alcohol stimulates the mucous membranes, causes dilation of the gastric blood vessels, increased secretion of the gastric juices and greater activity in the movements of the muscular layers in the walls of the stomach. It also tends to lessen the sensibility of the stomach and so may relieve gastric pain. In a strong solution, or when taken as whiskey, rum or gin straight, alcohol precipitates the pepsin as well as some of the peptones and proteids and thereby depresses or arrests

gastric digestion. The total effect of a small dose of alcohol may, however, in the aggregate favor gastric digestion.

Prof. Clouston of Edinburgh says, "Alcohol is a food and may in a *diluted form* be a very valuable adjunct to ordinary foods by exciting appetite, improving digestion and stimulating certain nutritive processes."

When the nerves, vessels and glands lack vigor, as in old age or chronic dyspepsia, a small amount of mild wine may at times be beneficial, but the great danger with alcohol lies in excess. When taken habitually and immoderately, alcohol helps time to produce the effects of age and may prove to be what Dr. Dickinson called "A genius of degeneration." In quantity, alcohol destroys instead of mildly stimulating, and causes a secretion of alkaline mucous which interferes with digestion and tends toward acute dyspepsia, chronic gastritis and ulceration of the stomach walls. Continued excessive alcoholic irritation of the stomach has been known to lead to overgrowth of connective tissue, atrophy of the gastric glands and permanent cessation of the gastric functions.

It has been frequently said that alcohol taken internally protects the body from infection but this is not true. Hydrochloric acid is the natural stomach guardian, and whereas alcohol is a preservative and of great industrial, pathological and domestic value, when fed to the stomach in any quantity, it tends to lessen the vital resistance of the body to infection. Prof. Metchnikoff has said, "Besides its deleterious influence on the nervous system and other important parts of our body, alcohol has a harmful action on the white blood cells—the agents of natural defense against infective microbes."

A single dose of strong alcoholic liquor, such as brandy, may produce valuable and beneficial reflex effects when administered pathologically to overcome fainting or swooning; it causes the heart to beat more rapidly and raises the blood pressure. Alcohol is quickly absorbed and it exerts a marked action upon the blood, causes the oxygen to be retained and hence diminishes the oxidation of the tissues; this naturally leads to the accumulation of unused fat and to the condition of obesity so often evident with those who habitually take much alcohol.

Alcohol is an antipyretic and is largely used in fevers as a means of reducing the body temperature. Sir Thomas Fraser says that nothing else can compete with alcohol as a food in desperate febrile cases, and in addition its great value in allaying fever and its narcotic action make it of great pathological worth if administered with much care, so that the nervous and circulatory systems of the patient are not deleteriously affected by the treatment. Alcohol is also used at times to advantage under medical direction for malnutrition, diabetes, etc. The use of any drug, at any time, is fraught with danger and should be discountenanced as much as possible, but alcohol is of as much use, pathologically, as any other drug, and possibly more, and it may prove of value under abnormal physical conditions and lessened health if used with intelligence and discretion.

### **Patent Medicines**

Patent medicines are consumed in the United States to an alarming extent, \$230,000,000 it is said being spent annually for this purpose. If any re-

form is needed in this country in regard to the use of alcohol it should be directed, and this at once, at the manufacturers and distributors of drugged alcohol potions which, advertised as panaceas with wondrous healing charms, are but vile, poisonous, narcotic concoctions with alcohol as the prime ingredient. The average patent medicine is "dope"; all are heavily drugged and none have any place in the life or stomach of an average healthy person or normal individual leading an average sort of life. The medicines—eliminants, neutralizers and tonics—that the body needs can be obtained by the intelligent use of food; and health can always be realized in full measure if we but obey the Laws of Nature in regard to our mode of life, or at least follow Nature's laws and take food and drink in harmony with the extent of our muscular activity. Many patent medicines are habit-forming and practically all are strongly alcoholic. If a person drinks beer, wine or whiskey he knows that he is drinking some alcohol and he is apt to be cognizant of the danger which ever accompanies the use of alcohol in any form. Many a person drinks a medicine exhibiting a blind faith in its healing power and without the knowledge that he is drinking alcohol. Moreover, many patent medicines contain drugs mixed with alcohol that produce a combination deadly to any human or animal constitution. In many cases the entire apparent worth of a medicine is due to its alcoholic content, and in other cases the alcohol in medicine is rendered deadly by its combination with vile drugs. A Committee to investigate Patent and Proprietary Medicines was appointed by the British House of Com-

mons in 1912. The report of this Committee says, in part: "There can be no doubt that many persons acquire the 'drink habit' by taking these preparations, either knowing that they are alcoholic, since they can be purchased and consumed without giving rise to the charge of 'drinking,' or in ignorance that they are highly intoxicating liquors. The further charge is made that their drug content may lead to the 'drug habit.'" Millions of suffering people are being persuaded by artful and unscrupulous advertising to purchase and swallow health-destroying compounds. The drugs that they contain may stimulate or result in apparent stimulation for a brief period and the victim imagines that he is being benefited; continuing the use of the much heralded nostrum, he ultimately may learn with sorrow that the poisonous concoction has augmented his ailment and reduced his vitality. Many a mind and body that could have been quickly restored to health by intelligent and natural eating and exercise have been blighted and even ruined by criminal commercialism.

Alcohol as a pure beer or a mild wine may, at times or under certain conditions, be beneficial, but alcohol as a patent medicine is usually the concoction of ignorance and avarice and its manufacture, distribution and consumption are reprehensible and criminal. Yet there are thousands and thousands of people in this country who denounce scathingly the use of alcoholic drinks and yet are unconscious victims and advocates of vile, alcoholic, drugged and poisonous potions, which they feel their systems demand at times and are habitually benefited by.

**Commercial Division of Alcoholic Drinks**

The alcoholic drinks of commerce can be generally divided into three prime classes:

1. Beer and Ales,
2. Wines,
3. Spirits or distilled liquors.

**Beer**

Beer is a beverage obtained by a process of alcoholic fermentation, mainly from cereals (chiefly malted barley), hops and water.

A history of beer extends over several thousand years, and beer made from malt or red barley is mentioned in Egyptian writings of 1300 B. C. Beer is a popular drink of the Anglo-Saxon and Teutonic branches of the Caucasian Race. The composition of beer can be roughly stated as:

Water,	90.0	per cent.
Albumen,	0.5	" "
Sugar,	1.5	" "
Mineral,	0.4	" "
Extractives,	3.1	" "
Alcohol,	4.5	" "
	100.00	" "

The consumption of beer and malt liquors in the greatest producing and consuming countries, is as follows:

Country	Year	Consumption in Gallons
United States	1914	2,053,457,082
Germany	1909	1,703,553,000
British Isles	1909	1,397,314,800
Austria	1908	492,941,000
Belgium	1909	411,735,000
France	1909	375,729,000
Russia	1908	231,445,000

The 1905 statistics give an average consumption of beer per person per annum as:

British Isles	27.9 Gallons
Germany	26.3    "
United States	19.9    "

The American consumption per capita has held at about 20 to 21 gallons during the past few years and later foreign figures are not available. It is estimated that the production of beer in the world in 1914 was 8,750,000,000 gallons, sufficient to fill the Panama Canal. The United States produced at the rate of 22 gallons per person, but Bavaria made 61 gallons and Belgium 58 gallons per person. At the other end of the scale is Japan, with less than half a pint per annum per person, or less than 3/10 of 1 per cent. of the American production; Spain produces on the basis of only half a gallon of beer per person per annum.

The great American beer producing states, according to the statistics for the year 1914, are:

New York	14,040,387 Barrels
Pennsylvania	8,008,786    "
Illinois	6,987,568    "
Wisconsin	5,278,989    "
Ohio	5,147,419    "
Missouri	4,142,160    "

It is also interesting to note that Prohibition states produced, according to government records, 712,946 barrels of beer; the Near-Prohibition states 7,606,113 barrels, the partially license states 30,-240,680 barrels, and the license states 27,589,416 barrels. Production is not consumption and the Prohibition states consumed a fair share of the beer manufactured in the country. A saloon or liquor shop licensed by the Federal authorities, but operating without state or local license, is known as a

"Blind pig," and it is a fact that not only are alcoholic beverages manufactured in Prohibition states to a certain extent, but they are widely sold through "Blind pigs." In the fall of 1914, as a result of inquiries, the Temperance Society found 766 Federal Licensed "Blind pigs" in the much heralded Model Prohibition state of Kansas.

There are many classifications of Beer, but the prime types can be stated as Ales (light color), Stouts and Porters (dark color) and Beer—light and dark.

The composition of typical beers has been given by various authorities as follows:

Description	Original Gravity	Alcohol Per Cent.	Solids Per Cent.
English Mild Ales	1055.13 to 1071.78	4.17 to 5.57	5.7 to 7.3
"    Light Bitters & Ales	1038.31 to 1050.30	3.81 to 4.61	3.2 to 4.1
"    Pale and Stock Ales	1059.01 to 1076.8	4.77 to 6.68	5.8 to 7.1
"    Stouts and Porters	1054.11 to 1081.62	3.90 to 6.14	4.5 to 8.8
Munich Draught Dark	1052.6 to 1056.4	3.38 to 3.76	6.45 to 6.58
"    "    Light	1048.05	3.18 to 4.05	3.92 to 5.55
"    Export	1054.3 to 1059.5	3.68 to 4.15	6.32 to 7.48
"    Bock Beer	1076.6	4.53	10.05
Pilsener Bottle	1047.7	3.47	4.90
"    Draught	1044.3	3.25	4.58
Berlin Dark	1055.2	3.82	6.17
"    Light	1056.5	4.36	5.46
"    Weissbier	1033.1	2.64	3.01
American Lager			
(Botton Fermentation)	1046.7 to 1063.4	2.68 to 4.12	5.08 to 7.43
American Ales			
(Top Fermentation)	1068. to 1084.2	5.50 to 6.46	5.53 to 8.60

Another table compiled from data recorded by various authors is as follows:

Description	Specific Gravity at 17.50 C.	Alcohol Per Cent.	Solids Per Cent.	Acids	Ash
Vienna Lager	1.017	3.70	5.71	0.008	....
Pilsener Lager	1.016	3.43	5.45	0.008	....
Munich Export	1.020	3.94	6.72	0.010	....
"    Salvator	....	4.78	10.67	....	....
Berlin Weiss-bier	1.012	2.82	4.21	....	....
Burton Pale Ale	....	5.37	5.13	0.16	0.55
Dublin Stout XXX	....	6.78	9.52	0.29	1.40
Milwaukee Lager	1.010	4.28	4.18	0.057	0.196
"    Bavarian	1.019	5.06	6.26	0.074	0.346
St. Louis Export	1.018	4.40	6.15	0.067	0.312
Philadelphia Lager	1.015	4.29	5.22	0.086	0.241

**Wine**

Wine is the fermented product of fruit or plant juice, the Wines of Commerce being made from the grape. The art of wine making dates back almost as far as we have historical records of any kind, and the wine production of the world to-day amounts to about four and a quarter billion gallons per year, France being the greatest producer, with Italy second.

Countries	Production in gallons
	1912
France	1,568,751,645
Italy	1,195,612,286
Spain	375,121,400
Algeria	176,232,588
Argentina	108,309,700
Russia	100,384,600
Portugal	95,761,625
Hungary	70,533,390

Germany appears as the eleventh on the list with 63,400,800 gallons, the United States is thirteenth with 42,267,200 gallons and Canada is twenty-eighth with 1,056,680 gallons. The wine consumption per capita in various countries is given in the following table:

Country	PERIOD	
	1891-1895	1901-1905
	Gallons per head	Gallons per head
France	23.0	30.8
Italy	20.6	25.1
Spain	21.1	18.5
Portugal	11.0	17.1
Austria-Hungary	2.9	3.9
Germany	1.19	1.45
United States	0.30	0.43
Britain	0.37	0.32

Wines are divided into many classes but the prime subdivisions are "charged" (i. e., sparkling), and "still" (i. e., non-effervescing). They are also classified according to color, i. e., white and red, and are named after the place of their production, or if Type Wines, after the place that first made the type famous. Champagne is the standard "charged" wine, and it is light in color; sparkling Burgundy is a popular effervescing red wine. German or Rhine wines are light in color, or "white." French wines are both white and red but claret is red and French Burgundy and Italian Chianti are more popular as red wines than as white.

The following table gives the analysis of certain "type" wines:

Description	Alcohol per Cent. by Vol.	Acidity	Solid Matter	Ash	Tartaric Acid	Sulphate	Glycerine	Sugar	Carbonic Acid
French	10.31	2.97	20.97	1.71	1.23	....	7.11	1.10	....
Clarets	to	to	to	to	to	....	to	to	....
	13.76	4.38	29.57	3.01	2.50	....	9.01	3.97	....
Cham-	12.56	3.23	19.78	1.05	2.04	....	6.50	1.32	7.75
pange	to	to	to	to	to	....	to	to	to
	14.44	5.22	30.33	2.53	2.76	....	9.05	13.86	9.55
Sherry	19.94	3.3	48.9	4.2	....	3.75	4.3	30.2	....

All the figures given, excepting Alcohol are in grams per litre.

### Distilled Spirits

The art of distillation and making spirits was apparently known to the Ancients, but distillation from grain did not become a popular industry in Northern Europe until the end of the Seventeenth Century. The principal spirit-producing countries in 1905 were:

Russia	170,000,000	Gallons
Germany	146,014,000	"
United States	125,042,000	"
France	160,584,000	"
Austria-Hungary	95,898,000	"
Britain	48,520,000	"

In 1914 the consumption of spirits in the United States was 146,397,253 gallons, which was about the same as 1913, but 10 per cent. over that of 1910.

With regard to the consumption in gallons, per head of population, the following figures are of interest:

Denmark	2.4
Austria-Hungary	1.98
Germany	1.43
Holland	1.42
France	1.37
Sweden	1.36
United States	1.26
Belgium	1.10
Russia	.95
Britain	.91

The manufacture of spirits consists broadly in converting starchy and saccharine matter into alcohol, the latter product being subsequently separated, concentrated, and rectified. Brandy and rum are sugar-derived spirits, and whiskey, vodka, gin and corn brandy are starch-derived spirits.

### Whiskey

Whiskey is a distilled liquor made from fermented grain mash and usually contains about 50 to 60 per cent. of alcohol. All Scotch whiskeys are distilled at about 72 per cent. of alcohol by volume, and mature whiskeys contain 45 to 60 per cent. of alcohol, according to age, humidity of storage, etc.

**Gin**

Gin is made in much the same way as whiskey, but the distilled liquor is left colorless and is flavored by distilling in pot stills with juniper berries, anise seed, etc. Holland gin is made from rye mash and is distilled only in pot stills with juniper berries. It contains about 40 per cent. of alcohol. The essential oil of Juniper is a powerful diuretic, i. e., it tends to increase the secretion and discharge of urine.

**Brandy**

Brandy is made by distilling wine or the fermented juice of other fruit, such as apples, peaches, cherries, blackberries, etc. The best Cognac is made by distilling a good quality of white wine. Brandy usually contains 47 to 54 per cent. of alcohol by volume; it owes its peculiar flavor to oenanthic ether. German Kirschwasser is Cherry Brandy.

**Rum**

Rum is made from fermented molasses or macerated sugar cane colored with burnt sugar. It usually contains about 55 per cent. of alcohol.

**Vodka**

Vodka was originally made in pot stills, of rye, with an addition of 20 per cent. of barley malt for saccharification; it is now made of potatoes and maize, with an addition of green rye malt. The spirit is manufactured at a strength of between 90 and 96 per cent. and then "broken down" for retail purposes to 60 and 40 per cent. of alcohol.

**Liqueurs and Cordials**

Liqueurs and cordials are usually strong aromatic alcoholic beverages compounded from grain alcohol with various flavoring essences. Absinthe, now generally outlawed, contained as high as 72 per cent. of alcohol and was extremely poisonous.

**Miscellaneous Alcoholic Drinks**

In addition to the above classification, many alcoholic drinks are made in the homes, such as fruit-juice wines (currant, elderberry, raspberry, cranberry, orange, gooseberry or rhubarb) and cider, and these decoctions generally contain from 5 to 12 per cent. of alcohol. Cider is usually produced by hand presses in family orchards. When newly pressed, sweet cider is generally wholesome, but it soon becomes intoxicating. When the alcoholic content has reached about 9 per cent., the ferment of acetic acid begins to work and it soon changes to vinegar.

Medicated wines are also on the market, but these are far more popular in Britain than in our country. Most of these wines contain 17 to 20 per cent. of alcohol and the manufacturer of one such wine advertises that their product "*gives a strength that is lasting, because in each wineglassful there is a standard amount of nutriment;*" this wine is also described as *the world's greatest tonic, restorative blood-maker and nerve-food*. Such statements are obviously false and misleading and, being impossible, they reflect upon the intelligence of the public.

**Comparative Consumption of Spirits, Wines, Beers, Etc.**

The following table shows the annual per capita consumption of malt and spirituous liquors in the United States covering a period since 1850:

Year	Spirits	Wine	Beers	Total
1850	2.23	0.27	1.58	4.08
1860	2.87	0.34	3.22	6.43
1870	2.07	0.31	5.32	7.70
1880	1.27	0.56	8.25	10.08
1890	1.40	0.46	13.67	15.53
1900	1.28	0.40	16.08	17.76
1905	1.42	0.41	18.02	19.85
1910	1.42	0.65	20.09	22.19
1914	1.46	0.52	20.52	22.50

**INCREASE IN THE PER CAPITA  
CONSUMPTION OF ALL ALCOHOLIC  
LIQUORS DURING THE LAST FIFTY  
THREE YEARS IN THE UNITED STATES.**

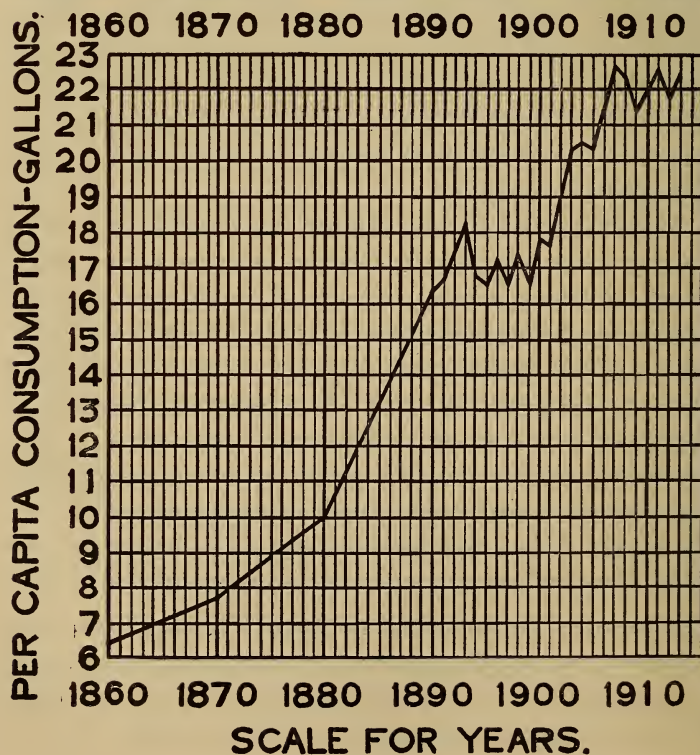


FIG. 23

During the past 50 years the average consumption of spirits per person has decreased 40 per cent.; the consumption of wines has increased 60 per cent. and the consumption of beer has increased about five times in 50 years and 13 times since 1850. There has been practically no increase in the consumption of alcoholic beverages per capita since 1906, the national consumption increasing with the increase of population, but remaining practically constant per capita.

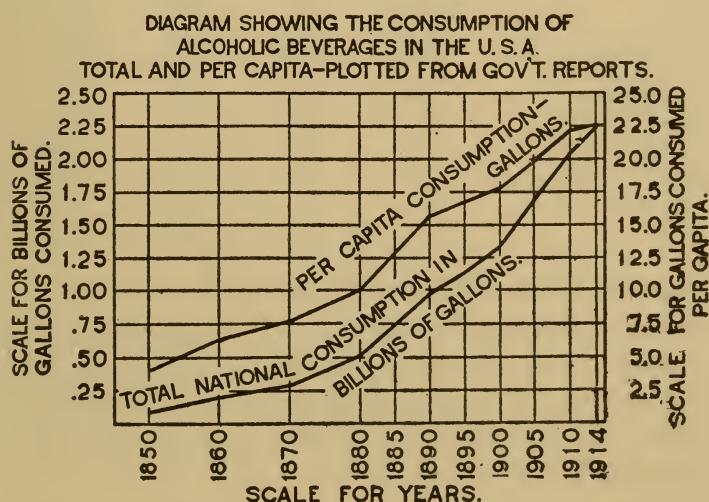


FIG. 24

The following table has been compiled by Dr. J. Gabrielsson on behalf of the Swedish Temperance Committee to show the comparative annual per capita consumption of whiskey, beer and wine in a number of countries during the years 1906-1910:

Countries	Whiskey (Liter 50%)	Beer (Liter)	Wine (Liter)	Pure Alcohol (Liter)
Norway	2.87	18.43	1.16	2.37
Sweden	6.8	23.8	0.5	4.9
Denmark	10.44	36.16	1.50	6.82
Finland	2.31	7.82	0.61	1.56
European Russia	6.09	6.52	0.86	3.41
German Empire	7.29	104.98	4.76	7.47
Netherlands	7.16	27.28	1.55	5.01
Belgium	5.47	220.82	5.16	10.58
Great Britain and Ireland	4.17	123.06	1.23	9.67
France	8.82	71.66	144.00	22.93
Spain	3.24	84.05	69.50	14.02
Portugal	1.04	0.95	92.58	12.59
Switzerland	3.82	69.01	55.65	13.71
Italy	1.02	1.63	128.58	17.29
Austria-Hungary	8.20	34.16	19.84	7.68
Roumania	5.50	2.39	23.62	5.20
Bulgaria	0.62	3.48	25.74	3.02
Servia	8.10	3.68	20.21	....
Greece	1.68	0.82	100.04	13.87
British South Africa	1.91	5.71	3.76	1.85
Australia	4.04	55.56	2.33	5.65
New Zealand	3.97	44.78	0.94	4.61
Japan	0.60	0.47	15.14	2.36
United States	5.51	76.25	2.37	6.89
Canada	4.23	22.61	0.42	3.31
Brazil	....	1.44	4.71	....
Argentine	8.44	3.14	41.56	10.21
Chili	....	12.26	91.24	....

### Economic Waste of Alcohol Consumption

The capital now invested in the manufacture of alcoholic drinks in the United States and the growth of the business is generally given in the following table—the figures being obtained from the U. S. Census Bulletins:

Census	Spirits	Wines	Malt Liquors	Total
1850	\$5,409,334	.....	\$4,072,380	\$9,481,714
1870	15,545,116	\$2,334,394	48,779,435	66,658,945
1890	31,006,178	5,792,783	232,471,290	269,270,251
1910	72,450,000	27,908,000	671,158,000	771,506,933

The Industry in 1910 employed 62,290 wage earners with a yearly pay-roll of \$45,252,000. The U. S. Statistical Abstract also showed that 169,449 persons were employed as saloon keepers and bartenders. The cost of material used in making

liquor during the year was stated at \$139,199,000. The total Federal Revenue from the manufacture and sale of alcoholic liquors during the fiscal year ending June 30, 1915, was:

Distilled Spirits	\$144,619,699.37
Fermented Liquors	79,328,946.72
<hr/>	
Total	\$223,948,646.09

The wholesale market value of alcoholic beverages sold in the United States per annum, as determined by the U. S. Census Bureau, is:

Value of Distilled liquors (spirits)	\$204,699,000
“ “ Malt liquors (beer)	374,732,000
“ “ Vinous liquors (wine)	13,121,000
<hr/>	
Total	\$592,552,000

The difference between this figure and the estimated cost to the consumer of from \$1,400,000,000 to \$2,456,000,000 represents the profit to the dealers and dispensers. The “American Grocer” estimates the retail expenditure at \$1,725,000,000; the various Temperance and Prohibition Societies give figures generally of \$2,250,000,000 to \$2,456,000,000. On the basis of \$2,000,000,000 annual expenditure for alcoholic beverages (the price paid for drinks over the bar is very high), the average cost per annum for an average family of five is \$100.

The Temperance Society of the M. E. Church maintains that the Liquor Traffic of the country costs each man, woman and child \$50 per annum. Their figures for losses and waste for a single year are as follows:

The retail liquor bill for 1914	\$2,290,000,000
7% decreased efficiency for 20,000,000 moderate-drinking workers	840,000,000
Partial lost time of 600,000 drunkards	270,000,000
“ “ “ “ 220,670 paupers and prisoners	99,301,500
Partial lost time of 207,791 insane and feeble-minded	31,168,650
Time of handlers and sellers of liquors	600,000,000
By premature death, 65,897	513,909,600
“ “ “ “ insane and idiots	240,899,600
Interest on 75% cost of alms houses, asylums and prisons	34,700,000
Three-fourths cost of arrests, etc.	60,000,000
Total	\$4,979,979,350

It is needless to say that these figures are but the estimates of enthusiasts. In 1913 the British United Kingdom with a population of 46,000,000, spent \$807,525,000 for alcoholic drinks, or \$17.55 per person, or \$31 per annum for each person over 20 years of age. The consumption of Beer for each man, woman and child averaged 27.3 gallons; spirits 0.69 gallons and wine 0.25 gallons, a total of 28.24 gallons per person and 49.13 gallons per adult over 20. It seems, therefore, that an average American family of five spends \$2 per week on alcohol, and a British family of the same size consumes over 25 per cent. more liquor and pays about \$1.69 per week for it. This amount of money invested in a high class Building Loan Association, or other institution that pays good interest and demands regular weekly or monthly payments, would grow to \$1,000 in about eight years and prove a most acceptable nest-egg for any family to fall back upon in old age or in case of adversity.

**Adulteration of Alcoholic Drinks**

A great evil accompanying the use of alcoholic beverages is the fact that a large proportion of such drinks are adulterated. Alcohol administered in the form of a pure wine or beer may at times perform desirable functions and under certain conditions be acceptable to the human system; pure whiskey may occasionally be used to advantage pathologically, but when alcoholic drinks are desired by intelligent people, they should be pure and as harmless to the system as it is possible to make a liquid containing a poisonous spirituous and intoxicating element. Alcohol itself has a deleterious effect upon the human system, but when "doped," and adulterated, alcoholic drinks are particularly blighting and an outrage to a long-suffering society. They are the product of unscrupulous, rapacious and parsimonious manufacturers engaged in an industry in which adulterations and falsification abound. The average whiskey contains harmful fusel oil, tannic acid and a large number of artificial impurities. There is no government guarantee of the purity of alcoholic liquids. Five, ten or fifteen year old whiskey may be made in a day by being treated with different chemicals and it is said that "Much of the 'Bourbon' and 'Rye,' which is supposed to come from Kentucky, is prepared in Illinois." The periodical of the liquor trade, *Barrels and Bottles*, recently said, "What will happen to our rectifiers if the day ever comes when the U. S. Pure Food regulations are tuned up to the Venezuelan standard of requiring labels indicating the actual ingredients of alcoholic beverages?" Distillers add creosote (also used to preserve ham and give it the desired smoky odor) to domestic

alcoholic product to make "Scotch Whiskey." Most of the "Scotch" sold in America is "faked," being but "a chemical decoction of various poisons added to the primitive poison of alcohol." An authority has said that over ninety per cent. of whiskey dispensed under the name of "Scotch" in this country is "fake," being merely alcohol colored and flavored with cheap coal tar products and glycerine, or cheaper glucose substitutes, to give it body. Unadulterated whiskey contains poisons other than alcohol but these should be eliminated in the process of manufacture and purification, instead of being intensified. Alcohol itself is a poison, but when poisons are added to poison "the drinker is given his alcohol with fierce degrading, tissue-destroying ingredients on the side." Vance Thompson tells us of an investigation held recently in Albany by the State authorities of New York, on which occasion a noted chemist showed the Commission the "tricks of the trade." The distillers and their experts, tasters and lobbyists were sent into an outer room. The chemist then filled a score of glasses with wood-alcohol while the Commissioners looked on with interest. In each glass he dropped different chemicals, making for color, odor or flavor. When he had mixed up doped drinks and brought them to the proper degree of strength and viscosity the expert whiskey men were called in. The professional tasters took up the glasses, one after the other; and they said, "this is rye whiskey, three years old—this is Bourbon whiskey—this is gin—this is fine Holland gin—this is Medford rum—this is brandy, five years in the cask—this is Scotch—this Irish"—and so on. Each of the liquors was in reality "faked" wood alcohol and they represented

as deadly poisons as the bodily tissues can be subjected to. When the tests were concluded the chemists explained what had been done and said, "An overwhelming per cent. of the liquors sold in the United States are made just that way." The wine fakers and beer fakers are no whit behind the distillers of strong liquors. Much wine is sold to-day that is entirely an artificial chemical product and that has had no connection whatever with a grape. Dr. O'Gorman, before the British Medical Association in 1900 said, "The markets of the world are incredibly flooded with imitations, adulterations and chemical trade mixtures (particularly in wines), so much so that even eminent wine merchants have declared the impossibility of the large majority of drinkers ever tasting even tolerably pure liquor." Dr. Lethaby, after investigating the Wine Industry of France and Germany, said, "A great part of the wine has ceased to be the juice of the grape at all. It is hardly possible to obtain a sample of genuine wine, even at first hand." It is said that there are nineteen hop substitutes and fifteen malt substitutes in use to-day in the manufacture of beer. Poisonous preservatives are used ranging from arsenious acid, a deadly poison, to salicylic acid which is injurious to the liver and kidneys, in an endeavor to make "dishonest" beer act honestly. The Committee on Food Standards of the Association of State and National Food and Dairy Departments declared "Malt beer has become extinct in America." The American Society of Equity, said to be composed of three million farmers, in a resolution denounced the preparation of beer from "deleterious ingredients," asserting that such beer was sold as a pure barley and hops

product, and the National Consumers League has declared that "beer is often made of glucose, sugar, rice, *rotten corn*, starch, *preservatives*, *beer color*, etc." Pure beer can be kept indefinitely, but the average American beer has to be kept away from the light and even dark bottles are being advocated to retard putrefactive fermentation and its explosion into rottenness. Authorities have said that if European laws, in regard to the manufacture of beer, were made effective in this country they would put American brewers out of business, as we make practically no beer of malts and hops in this country that can be lagered—that is, stored for three months. It has also been said that when beer in certain European countries is condemned as bad, the governments of these countries permit such beer to be exported, and this beer generally goes to the countries which, like America, accept it without inspection and test.

#### **Fraudulent Advertisements**

The false and diabolical advertising of alcoholic beverages should be prohibited by law, as this practice is opposed to the policy of that true education which alone can correct the alcohol evil. A manufacturer of whiskey claims that it is invaluable for "run-down women and delicate, undeveloped children," whereas any strong alcoholic liquor would be a deadly poison to them. Such advertisements are obviously fraudulent and a national calamity. Prof. Nothnagel of Vienna has said, "It is a sin to give children wine or beer. It is criminal to teach that wine nourishes. The dreadful neurasthenia of our day is due just to this early use of alcohol." We see it in the papers that "Beer is liquid bread,"

and, of course, bread is the staff of life, therefore, beer is a similar nutrient and sustainer. Pure beer, scientifically made, could be used occasionally in moderation by many people to advantage and it would be far healthier than the excessive or even moderate use of many popular "drugged" temperance drinks, but by no stretch of the imagination can beer be considered a food substitute for bread. It has been said that in the making of beer the sprouting, soaking and growth of the yeast plant in the liquid destroys practically all the food value of the original grain. Baron Von Liebig, the German scientist, says, "It is now possible to demonstrate with mathematical certainty that, so far as enriching the blood is concerned (food value), the flour that will lie on the point of a knife affords more nourishment than four measures of the best Bavarian beer; and that anybody who drinks a measure of beer daily would thus imbibe in one year about as much nourishment as is contained in a pound of bread."

In a Syracuse, N. Y., paper of April, 1916, appeared a "scientific" beer advertisement of a quarter page, headed, B—r and other Foods. The advertisement reads, "There's food value in beer—as well as beverage enjoyment. A bottle of——may not be offered as a complete meal, but it has its place in the meal *comparable to bread, milk or any other of the dishes or drinks* that are part of the well-balanced lunch or dinner." (The italics are mine.) After other statements are made regarding the merits and food value of beer ingredients, a chart is printed claiming to show graphically the comparative alcohol content and nutritious extract content of whiskey, wine, beer and milk and then appears the following table:

Average Composition of	Bread		Milk		Beer		Rhine Wine		Whiskey	
	Per cent.		Per cent.		Per cent.		Per cent.		Per cent.	
Carbohydrates	52.0		4.8		5.0		2.25		None	
Protein	7.0		3.5		0.5		None		None	
Fat	0.4		3.7		None		None		None	
Mineral Substances	1.0		0.7		0.2		0.2		None	
Alcohol by Weight	None		None		3.75		8.0		40.0	

The chart accompanying this table, if scaled, shows the following comparative nutriment of the liquids considered:

Milk	100
Beer	46.2
Rhine Wine	20.8

As milk has a calorific value, or food value, of 675 calories per litre (1,000 grams or 2.2 lbs.) then beer is shown to have a food value of 312 calories per litre, and Rhine wine 140 calories. The brewery and dealers behind this advertisement have, therefore, decided in the interest of their business to eliminate alcohol, which is a carbohydrate, from their tables and charts. They, therefore, unconsciously denounce alcohol, graphically portray it as a deleterious agent but ignore it as a carbohydrate, for if they did not do so, their charts would show whiskey and wine possessing far greater food value than beer.

Prof. Lusk, one of our greatest dietetic authorities, says that a litre of German beer "contains 3 to 4 per cent. of alcohol and 5 to 6 per cent. extractives. It yields 450 calories to the body, only half being derived from alcohol, the rest from the dextrine and protein-like extractives." Atwater and Benedict have shown conclusively that alcohol is a food when used in small doses and it can, scientifically considered, take the place economically of fat and carbohydrates in metabolism. The conditions re-

quired are that alcohol shall be administered in very small doses not exceeding in the aggregate 72 grams of alcohol—500 calories per day, that the person is perfectly healthy and that the test covers only digestion and metabolism and not brain or motor efficiency, quality of work performed or effect upon the nervous system. They used in their daily tests alcohol equivalent in the aggregate to that contained in a bottle of claret, administered in 6 doses; the alcohol furnished 20 per cent. of the total food fed per day for 23 days to a man doing no work (2,500 calories) and it represents about 14 per cent. of the food fed to the man at work consuming 3,500 total calories per day. Alcohol under no condition can serve to repair and build tissue, and unlike other foods, it acts as a drug in a manner which may, unless judiciously used, outweigh all its theoretical usefulness as a food and even interfere with the digestion and absorption of other foods. But why should beer advertisers consider all the extractives in their product of food value, which experts seriously question or deny, and ignore alcohol from their computations of carbohydrates and food value charts? Considering alcohol and the extractives given in the before stated tables, the food value of the substances becomes

Whiskey	2800 calories
Bread	2446 “
Milk	684 “
Rhine wine	652 “
Beer	488 “

Hence whiskey, the product of the distilleries, which the breweries to save themselves have decided to stigmatize, has a greater “food” value than bread

and four times that of milk—nature's liquid food, an obviously absurd conclusion. Scientific investigations, including those pursued by the U. S. Government, have resulted in alcoholic beverages being given "food value" generally as follows:

Beverage	Calories per litre	Beverage	Calories per litre
Brandy-cognac	3900	Martini Cocktail	1750
Benedictine	4400	Port Wine	1500
Crème de Menthe	3700	Sherry	1400
Jamaica Rum	4900	Rhine	690
Rye whiskey	3040	Champagne	830
Gin	2320	Claret	670
Ale	620	Cider	520
Porter	560	Lager Beer draft	480

All such figures are erroneous for they fail to consider the effect of strong or immoderately used alcoholic liquids, physiologically upon the human body and its delicate nervous system. Alcoholic beverages should, therefore, only be considered pathologically and medicinally and not as nutriment. Alcohol administered scientifically in small doses in illness is a food to a limited extent. It may sustain and does save life in cases of acute disease; when the body is in an abnormal condition, it may also be used to great advantage, with care and judgment, but no alcoholic beverages should ever be taken habitually and in health as a food. If beer were "liquid bread," as is claimed, then a person should be able to obtain from beer alone all the nourishment required to sustain the body doing manual muscular work. According to a brewer's advertisement, this would be obtained by drinking about 23 bottles of beer per day, but the alcohol content (accumulative) would prevent assimilation

of the claimed extractive nutrients, and, moreover experts say that these extractives have no real substantial food value, hence we again reach an inevitable conclusion which must be stated as *reductio ad absurdum*. The following is an extract from an official Army pamphlet entitled "Alcohol and the Power of Resistance" circulated among German soldiers:

"There is no justification for calling beer 'liquid bread'; a glass of heavy beer costing twenty-five pfennigs has no more nourishment than a piece of cheese costing one pfennig. Almost all excesses and disturbances in the army are traced to drink. . . . It is mostly beer that causes the mischief. Beer is not the harmless drink it is supposed to be."

A British manufacturer of ale advertised that "A glass of good beer (English ale is probably referred to) is as *nourishing* as a glass of good milk." An American brewer says that a glass of beer is 46.2 per cent. as *nourishing* as a glass of milk, but the figures he submits indicate that theoretically, by chemical analysis, it should have food value equivalent to 71.4 per cent. that of milk. On this same basis English ale would theoretically approach the food value of milk. Such reasoning is, however, false in every detail, for ignoring the presence and effect of alcohol, we find that (1) milk contains nutritive fat as cream; beer has none; (2) milk contains a useful nutritive sugar, as a carbohydrate; the carbohydrate of beer is only one-fourth sugar, the balance being a gummy residue useless for purposes of nutrition; (3) milk contains flesh-forming albumen or proteid, whereas, beer contains a very small quantity of nitrogenous proteid which is mostly in the form of ammoniacal and amido-products, which are excretory and non-nutrient. Dr.

Bowers, discussing the nourishing properties and food value of beer, has recently written:

"We know exactly how much nutriment a glass of beer contains. It contains about five per cent. of malt extract—or one part in twenty, the food value of which is variable.

"This extract consists of protein matter, converted and unconverted sugar, hop resin, and other substances of no dietary value, left as a residue after complete evaporation. In addition, beer sometimes contains preservatives, such as sodium fluoride and salicylic acid, together with soda bicarbonate to neutralize the acidity, and to help put the foaming 'head' on it; also salt, to overcome the disagreeable taste—and perhaps inspire a languishing thirst for more of this 'liquid food.'

"Dr. Wiley some time ago very effectually disposed of the status of salicylic acid and preservatives, and even the most enthusiastic exponents of 'food in beer' will hardly urge the use of hop resin as an article of diet.

"As regards the recent claims that lecithin, or 'nerve fat,' has been discovered in beer, this is interesting, if true. If it has—despite all the painstaking negative analyses of many generations of chemists—it is quite safe to estimate that the total amount contained in four carloads of beer might approximate the quantity concealed about the person of one vigorous fresh egg. Which would give it a nutritional value almost as high as that of the hole in a doughnut.

"This leaves us a few grains of proteid and a small amount of sugar as the 'food' in beer. If the tissues are supplied with a liberal amount of water—although no one claims water as a food *per se*—life can be sustained for a very considerable time. Doctor Tanner fasted for forty days. Perhaps some beer-encouraged expert might do even better. He might if he could rid the beer of its four or five per cent. alcohol content—a content that in the absence of other food to attack would prey upon the tissues like a myriad of infinitesimal teeth. But if he did, the genial draft would no longer be beer."

It is to be regretted that the present attitude on the part of brewers not only involves their divorce from the distillery interests which is reasonable and the extension of the European idea of Café and Beer Gardens which is good business, but they seem determined to entice women and children to be con-

sumers and champions of their product. The *Brewers Journal* has said, "The franchise will be extended to all women in this country—some day," and adds, "It will be comparatively easy to convince the women voters that beer and light wines are not detrimental to those accustomed to consuming them. The rapid development of the bottling trade shows that beer is a welcome adjunct to the family meal and women themselves enjoy taking a glass of beer in their own homes." On October 1, 1914, the "*Journal*" said, "Newspaper advertising for beer should be designed to attract and appeal to women as well as men, for if beer is to be used in the home women must be won over to it." Hence the public are told that beer is "liquid bread," that it is a food, a tonic, a blood enricher, an appetizer, nerve soothing, energy and strength creating, digestible and nourishing as well as thirst-satisfying. Modern advertising is illustrated with women drinking and serving beer and the psychological effect must be great as well as diabolical. Beer is also recommended for nursing mothers and even for children and when any alcohol is advocated for minors the campaign, whether it be to exploit beer, wines, spirits or patent medicines, becomes criminal.

#### **Bevo—A Temperance Beer**

A new type of Beer, named Bevo, which is claimed to be satisfying, palatable, wholesome and non-intoxicating, has recently been placed on the market by the Anheuser-Busch Brewing Association of St. Louis. Bevo is a brewer's response to the prohibition agitation and an attempt to safeguard a business by producing products which conform to popular demand. Bevo, we are told, tastes

like beer, contains practically the same ingredients as beer and though possessing a negligible amount of alcohol (less than one-half of one per cent.) "has been served in beer bottles to beer drinkers for two hours continuously without their discovering that it was not the usual beer." Without commenting on the absurdity of such a statement, it is evident from the testimony of many men, competent to pass an unbiased opinion, that the Anheuser-Busch chemists have, after several years of research work, produced a beer-substitute far superior to any of the horrible Near-Beer beverages which have been brought forward in the past to wean beer drinkers from their favorite alcoholic beverage. The producers and their enthusiastic friends tell us that Bevo has real food value for it contains rich malt and Saazer hops. "Science has taken nature's finest cereals and pure water and by following nature's own processes, has blended them into a bright, lively, foamy and nutritious beverage." Again we are told that "Bevo is a pure drink, composed of harmless ingredients. It is less dangerous than milk and water, particularly in the summer time, for it is a pasteurized product, put up in sterilized bottles." Apparently the aggressive advertising resorted to by brewers to stem the tide of temperance, is to be continued in making a market for beer-substitutes, so Bevo will probably be advocated as a milk substitute and described as Liquid Bread. No beer or beer-substitute can ever take the place of milk which is nature's food drink, nor can any so-called temperance beer ever be considered comparable as a food and healthful drink with a fermented milk of similar alcoholic content.

The United States Revenue authorities and the St. Louis Health Commissioners have classed Bevo, in a legal sense, as non-alcoholic, and the St. Louis Park Commissioner, upon the findings of the City chemist, has granted to venders permission to sell it in the public parks the same as Coco-Cola, Ginger Ale, Soda Water and other soft drinks.

It has been said that "Bevo is to beer what postum is to coffee—all the virtues with the bad effects left out," but postum does not possess the virtues of coffee and it has evils peculiar to itself. If Bevo is to stand the test of time, it must be a far better substitute for beer than is postum for coffee, and being deprived of much of the alcoholic content of beer, the public will grow to be more critical in regard to the wholesomeness of Bevo and similar beer-substitutes. The real healthful temperance drink of the future, mildly stimulating and wholesome, will probably be found in an Americanized modification of old fermented effervescent soured milks, with very low alcoholic content—not greater than that of Bevo. Such a drink will have real food and "lifting" value and tend toward health and longevity.

### **Alcoholism a Vice of Certain Races**

Alcoholism can be considered primarily as a vice of the Christian branch of the Caucasian Race. Heavy drinking has been a peculiar blighting characteristic of the dominant, aggressive, blonde Teutons, Scandinavians, Anglo-Saxons and other northern branches of the race; the more southern or brunette Caucasian being given to more temperate but habitual consumption of the lighter wines. Drunkenness among women in England, Scotland

and certain other northern European countries is fearfully common and most deplorable, for the effect of alcohol upon women, because of their more sensitive nervous organism, is inevitably worse than its effect upon men. The subjugation of other races by the dominant northern Caucasians has resulted in their vices, as well as their virtues being foisted on many foreign peoples. Alcohol has done much to cause or accelerate the degeneration of peoples, peculiarly unfitted temperamentally and physically to withstand its ravages. There are peoples, however, such as religious followers of Mohammed who have refused, because of the teachings of their prophet set forth in the Koran, to partake of the "delights of alcohol" although they do use immoderately the drug caffeine in the form of coffee with syrupy consistency. The word "alcohol" is derived from the Arabic al-kohl, meaning "evil spirit." It is said that Lascar sailors, who visit the ports of the world, can be allowed shore leave with implicit confidence that they will return to their ship as sober as when they left it. Stiles tells us of a seaman who, erring in this respect and being remonstrated with by the captain, naively excused himself for his inebriated condition on the ground that he had embraced Christianity.

The use of alcohol in China is not extensive as yet, but Caucasian manufacturers and dealers of alcoholic beverages are doing what they can to rapidly fix drinking customs upon that country. Large plants have recently been built in China to produce what the Chinese call "the Jesus poison"—a horrible profanation, but quite justifiable considering Caucasian aggressive dominance in both religious and commercial fields. In Japan,

drunkenness was practically unknown until after the Revolution of 1868, and now when an intoxicated man is seen on the street, the natives are apt to say, "Here comes a Christian." The wag who took the scroll out of the extended right hand of the angel figurehead of the Missionary Ship building at Bath, Maine, (the left hand firmly clasped a bible) and substituted a bottle of whiskey horrified the earnest religious builders, but nevertheless symbolized the history and record of the Caucasian in world conquest. As late as 1901 an International Conference was held in Brussels, at which representatives from seventeen countries, including the United States, were present, to effect an agreement to check the alcohol evil in Central Africa. The articles agreed upon which practically established prohibition, were rectified by the various governments and in one decade the consumption of liquor in Nigeria alone increased 61 per cent. Despite the sentiment manifested, the so-called civilized countries of the Caucasian Race have disgraced themselves repeatedly by their attitude toward the Foreign Liquor Trade. Since the Brussels Conference the various nations have vied with each other to "get the business" and it is said that representatives of the U. S. Government were responsible at one time for the reduction of the tariff on importations of liquor into African territory. The manufacturer of alcoholic beverages in this country is not required to pay the usual government tax if his product is exported, and therefore Foreign Trade in alcohol is encouraged. The government of a "highly civilized" nation, through its agents, has been known to forbid in its possessions, the organization of temperance societies designed to protect the natives from alcoholism.

**Effect of Alcohol on the Individual**

In small quantities alcohol generally produces a feeling of well-being, along with increased confidence in one's mental and physical powers. Larger quantities usually lead to excited nervous conditions, marked by laughter, loquacity and gesticulation; the face becomes flushed, the pulse is quickened, the eyes shine brighter; the tongue is loosened and the will power is weakened. The loss of self-control may be indicated by violent outbursts of temper and expressions of egoistic unreasonableness, or by the indulgence in maudlin sentimentality. As Cushny says, "The sense of responsibility and the power of discrimination between the trivial and the important are lost in a man under the influence of alcohol and the individual has no regard for the feelings of others, or the ordinary conventions of life. If the bout be further continued, the movements become uncertain, the speech becomes difficult and stammering, the walk becomes a stagger and a torpid slumber follows." The after-effect of the excessive use of alcohol is great depression, sometimes accompanied by nausea, headache, lack of appetite and acute gastric catarrh. Alcohol is hostile to application and true perserverance. It dissipates one's forces and "scattering" rather than "concentrating" is the essence of the mental state produced. Alcohol is not conducive to original work. Schiller truly wrote, "Wine never invents anything," and Helmholtz said, in reference to the inspirations of genius, "the smallest quantity of alcohol seems to scare them away." *Stimulant* and *narcotic* are in reality opposing terms and alcohol is never a true stimulant, and in quantity is positively a narcotic. Tea and

coffee taken moderately are stimulants, but like all other drugs tend to irritate and detrimentally affect the system. Stimulation should be unnecessary for those whose health is what it should be, but when there is work to be done, and drugs are taken, it is generally preferable to partake of that which concentrates our forces, such as a cup of coffee, rather than that which scatters our forces, such as alcohol. It has been said that we tacitly contrast alcohol, a narcotic, with coffee, a recognized stimulant, when we acknowledge the difference between the feelings with which we should view the use of one and the other by the engineer of an express train. We instinctively feel that coffee will favor his unswerving attention to duty, keep him wide-awake and mindful of his responsibility, and that alcohol would make him less reliable and less mentally efficient.

There is a great difference between what a man thinks that alcohol does for him and what an impartial investigation really reveals. Stiles says, "The subjective impression is often an exaltation of capacity which objective testing fails utterly to confirm. A subject does certain problems before taking a drink of whiskey and comparable ones afterwards. He says that the second task was done with greater speed and with a nonchalant confidence in his results. The watch says that he was slower, and checking up the work shows that errors were more numerous. It is evident that his judgment of his own performance is unreliable." This is true also of manual operations. Alcohol tends to make a man bolder than he is by nature, or shall we say more foolhardy with an inhibition of the sense of proportion. There is an excellent little story told

of a mouse which came upon a little pool of whiskey spilled upon the floor. He drank and drank again; then he cocked up his little head and boldly said, "Where's that cat that was chasing me yesterday?"

Dr. Bowers, who writes so entertainingly upon medical and physiological subjects says, satirically, that if one must drink alcohol, the only way to drink it is to consume an entire month's allowance in a night or two, get it over with, sober up and let the system, if it can, recover a tolerable degree of normality once more. "If you must get drunk," he says, "go into training for it, get into the very pink of condition—and afterward sleep off the effects, first eliminating all the alcohol possible through the pores in a Turkish bath, then sleep in the open air, or in an exceptionally well-ventilated chamber. Never get intoxicated when you are fatigued. Be fit in every way; for in proportion as you are tired, a 'jag' will do harm—the more fatigued, the more harm. But perhaps the surest way to miss contracting a 'morning after' cough will be to save all your alcohol for the alcohol lamp."

Speaking of the effect of alcohol on the nervous system Dr. Bowers writes, "It is the steady drinker who develops screaming nerves and the other symptoms of neuritis. Women, because of their highly organized nervous systems, and the tension under which many of them exist, are particularly liable to attacks of alcoholic neuritis—which goes to show that, whatever else he may or may not do, King Alcohol gives women their rights—perhaps even more than their legitimate share of them. A very simple and highly effective method of caring for this form of neuritis, provided the nerves haven't got the habit, is to stop drinking."

Alcohol is an anesthetic of considerable power, and under its influence one feels less keenly, or not at all, physical or mental insults. The use of large quantities leads to a deep torpid sleep which eventually passes into total unconsciousness, resembling the condition in chloroform anaesthesia. Alcohol anaesthesia lasts much longer than that of chloroform and ether. It is said that persons rarely or never recover from alcoholic stupor if unconsciousness lasts longer than 10 to 12 hours after the drinking bout, death being due to failure of the respiration.

Alcohol under certain conditions acts as a mild hypnotic. A comparatively small quantity of beer or spirits and water taken before retiring often operates to secure quiet and refreshing sleep. With some persons, however, such a use of alcohol tends to give intense sleep for a contracted period, followed by positive wakefulness.

Stiles, discussing the use of alcohol in his work on Nutritional Physiology, aptly and forcefully says, "The hygienic ideal to be striven for is a robustness of life which shall make alcohol superfluous as relish, food or drug and a cheerful, active mind which needs no artificial aid to keep it hopeful and sympathetic. The attainment may not be an easy task. Grief, worry and overwork may be added to an original depression of temperament, but the use of alcohol is never more unsafe than when sorrows are the excuse, and never so selfish and cowardly as when the motive is to shun responsibilities that ought to be faced. Men do not often see the sinister suggestion in the high spirits of one who has forgotten his cares for an evening by the most moderate indulgence. They fail to see that the banishment



# EFFECT OF ALCOHOL UPON HUMAN EFFICIENCY

NATURE OF TEST	APPARATUS USED	NOTES REGARDING TESTS	Index of Average Capability Determined during Abstinence from Alcohol Recorded as	Index of the same Men's Capability after Moderate Use of Alcohol	Decreased Efficiency due to the Moderate Use of Alcohol Percentage
A.—Capacity for Work and Physical Endurance.	1 { Mosso Ergograph.	{ Alcohol administered, as glass of Bordeaux Wine after meals.	100	92 to 92.4	7.6 to 8
	2 { Schnyder Ergograph.	Two glasses of Beer for ten (10) days.	100	91.4	8.6
B.—Writing Balance. Speed and Accuracy.	Graphical Time and Writing Balance.—Kraepelin—	Alcohol same as "A." As Tests became more complex and required more intelligence, the use of Alcohol showed a lowering of Speed and Efficiency.	100	93 to 94.4	5.6 to 7
C.—Co-ordination Test with flash of Light, Sound Gongs and Snap Switches.	Chronometer Recording Time Intervals.	Alcohol same as "A." The more difficult the Test, the more pronounced becomes the lessened Efficiency due to use of Alcohol.	100	91.7 to 94	5 to 8.3
D.—Accountant Test. Speed in Adding Columns of Figures.	Stop Watch and Inspection.	Alcohol administered as one pint of Light Beer. Test kept up for two weeks.	100	96.9 (After 1 Day) 84.7 (After 2 Weeks)	3.1 (After 1 Day) 15.3 (After 2 Weeks)
E.—Typesetter Test. (Composition Work)	Stop Watch and Inspection.—Aschaffenburg—	Moderate Drinks same as above.	100	91.3	8.7
F.—Memory Tests.	Accuracy Tested by Positive Examination.	Moderate Alcoholic Drink each morning.	100	98.8	6.2
G.—Memory Tests.	Dr. Vogt, Christiania. University Method.	Half Pint of Beer containing 4% Alcohol.	100	82	18
		When system became used to Alcohol.	100	93 to 95	5 to 7
		Moderate drink on empty stomach before Breakfast.	100	81	69
H.—Association of Ideas.	Positive Examination.	After evening's "Night Cap" Moderate Drink.	100	73	27
I.—Vision.	Reading Signs from Varying Distances.	Alcohol administered as Pint of Beer. The effect of one drink did not wear off until 4 or 5 hours had elapsed.	100	66.7	33.3
J.—Complex Co-ordination Test for Time and Accuracy of Color.	Colored Flags and Electric Push Buttons with recording device.—Kraepelin—	Alcohol administered as Glass of Wine after Meals. Efficiency figures are given for speed. Errors greatly increased with use of Alcohol.	100	87 to 94	6 to 18
K.—Sense of Touch and Muscular Sense.	Three Point and Dial Machine.—Ridge—	Fourteen experiments on five persons. Also tests Judgment and Power of Perception.	100	85	65
L.—Accuracy in Type-writing.	Stop Watch and Positive Examination.—Heidelberg—	Alcohol administered as 1 quart of Beer.	100	87.5	12.5
M.—Accurate Shooting. Quick Firing.	Target and Inspection.—Mernetsch—	30 shots in 30 seconds. Swedish Army Tests. Moderate Alcoholic Doses.	100	12.5	87.5
N.—Shooting Endurance.	Target and Inspection.—Mernetsch— Shooting for Points.	Firing until exhausted. Swedish Army Tests. Moderate Alcoholic Doses.	100	77.2	22.8
O.—Attention.	Dots Moving Past Opening at Determined Rate.—McDougall—	Alcohol administered as 3 ounces of Whiskey.	100	62	38

The above tests demonstrate that the impressions on the mind during alcoholic days are not as permanent as on days of total abstinence. Alcohol taken on an empty stomach is extremely powerful in its action; taken before breakfast it is deadly if one hopes to perform efficient mental work. The more complex the psychological function, the more is it detrimentally affected by the use of Alcohol. The human system tends to gradually adjust itself to the persistent moderate use of Alcohol, but the efficiency of the individual, physiologically and psychologically is less than that of the same person adjusted to the plane of abstinence. The effect of Alcohol administered pathologically will be pronounced upon an abstainer, but probably has little effect and therefore has low medicinal value to a steady, though very moderate, drinker. Moderate drinks of Alcohol lower one's speed of thinking and muscular action, lessen accuracy of action, mar judgment, tend to deaden memory, reduce vision and lower power of endurance and capacity for performing work.

of sense of pressing duties is the very characteristic of the drunkard. When developed to a logical extreme it makes him indifferent to every obligation of conscience and love."

#### **Effect of Alcohol on Endurance**

Prof. A. Von Bunge, of Basel, Switzerland, has found, by repeated experiments with soldiers, that the regiments which were not supplied with alcohol, marched further and were in better condition at the end of the day than others to whom it had been given. Prof. Durig's experiments in climbing Mt. Bilkencrat (altitude 8,000 ft.) show that less work is performed with alcohol than without it. The Swiss scientist climbed with and without alcohol and found by carefully adjusted instruments that after drinking two glasses of beer he expended 15 per cent. more energy but took 21.7 per cent. more time to reach the top of the mountain. He was more prodigal in regard to the expenditure of his forces when under the effects of alcohol but his energy was wastefully applied and inefficiently consumed.

Muller, of Stuttgart, says that the higher the climber goes, the less alcohol he should take. The German and Austrian Alpine Union have taken an official and unreserved stand that alcohol and mountain climbing have nothing in common. One of their rules reads, "Avoid alcohol both on the eve of setting forth and on the tour itself."

#### **Scientific Study of the Effect of Alcohol on the Human Machine**

Rudin made tests to determine how long the intellectual abilities continue to be depressed after the immediate toxic effects of alcohol have had time to pass off. His experiments showed that the effect



# EFFECT OF VISCOSITY UPON PUMP EFFICIENCY

Viscosity	Pressure	Flow	Efficiency	Notes
100	100	100	100	Standard conditions
200	100	100	100	Standard conditions
300	100	100	100	Standard conditions
400	100	100	100	Standard conditions
500	100	100	100	Standard conditions
600	100	100	100	Standard conditions
700	100	100	100	Standard conditions
800	100	100	100	Standard conditions
900	100	100	100	Standard conditions
1000	100	100	100	Standard conditions

of a single dose of alcohol taken in the evening persisted until the morning and noon of the next day. Kürz said that after taking alcohol for 12 days he experienced decided diminution of calculating and study abilities which did not wear off entirely until the fifth day of his abstinence period. A single large dose of alcohol had after effects which marred his work for 24 hours and sometimes longer.

Dr. Edwin F. Bowers has said, "Studies in exact science made under the strictest conditions, indicate that alcohol depresses, anaesthetizes and narcotizes and that its first effects on the nerves are to diminish acuteness and pervert activity. Sending the blood to the head where it surges through the brain with increased velocity is not increased vigor but increased irritation which comes just before anaesthesia and diminution of power. The drinker deludes himself for he only *thinks* he is thinking. His very first drink has produced a definite measurable degree of intoxication—experts say that a little drink will set you back about 7 per cent. in muscular endurance and about 15 per cent. in your ability to remember things."

The accompanying table has been prepared from exhaustive tests made in various parts of the world, by recognized experts and unbiased scientists, to show the effect of the moderate use of alcohol upon the efficiency of the average healthy human machine. To determine the index of 100, the men who were later given alcohol were generally subjected to tests under a condition of total abstinence, of sufficient duration so that their average capability could be scientifically determined after they became familiar with the tests and were in harmony with their environment. The tests with alcohol were generally

conducted with the same subjects immediately following the total abstinence tests. A large number of subjects were usually chosen for each test and the average results or the range of the results obtained are herewith recorded.

Kraepelin, whose tests with alcohol at Heidelberg and Munchen were epoch-making, has said that fatigue reduced accuracy in typewriting 12.5 per cent. but a quart of beer would reduce the

### Effect of Alcohol on Memory

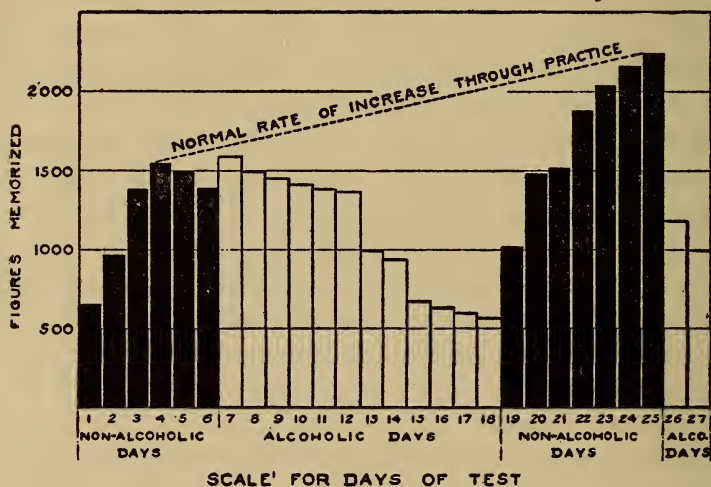


FIG. 25

efficiency of one's work as much as the condition of physical fatigue. He has also said that during a period of entire abstinence he learned to memorize 100 figures after 40 repetitions, but after taking alcohol moderately he could only memorize 60 figures after 60 repetitions.

Experiments conducted in the Kraepelin Laboratory at the University of Heidelberg, by Prof. Smith, have been graphically plotted to show the

effect of time and accumulative alcoholic drinking upon various mental processes. The accompanying chart gives the results of some experiments with memory. For half an hour each day, time was given to memorizing as many numbers as possible. Days 1 to 6 and 19 to 25 inclusive are abstinent days, and days 7 to 18 and 26 to 27 are alcoholic days. On days 5 and 6 a temporary illness caused a decrease in the amount of work done. Alcohol was taken in the evening in an amount equivalent to  $1\frac{1}{2}$  to 3 pints of 5 per cent. beer, so the work of memorizing was done 8 to 10 hours after taking alcohol.

Other experiments were conducted by Prof. Smith to test the effect of alcohol on such habitual association of ideas as are involved in adding figures. The conditions of the experiments were similar to those of the memorizing experiments. Ability to add was markedly impaired, being about 35 per cent. at the end of the twelfth alcoholic day. Both the memorizing and adding tests showed good results on the first alcoholic days but the accumulative detrimental effect of alcohol was soon in evidence and at the end of the twelfth alcoholic day the record of performances was extremely low and tending still further downward. In each test the first day's abstinence gave an immediate improved showing and the gain to normal was accomplished in a few days, to be promptly lost when the use of alcohol was renewed.

Unfortunately we are not informed whether the experiments herein described were made on persons accustomed or unaccustomed to the use of spirituous drinks and it is well known that subjects who are habitual users of alcohol show results in such experiments much less unfavorable to drink than do ab-

stainers. We would not seek to determine the injury from using tobacco simply by setting persons wholly unaccustomed to it to the task of smoking cigars. It is undoubtedly a fact that the human body can become, to a certain limited degree, tolerant to the injurious effects of a poison habitually taken, but the plane of equilibrium that is apparently established is apt to be, both mentally and physically, below that which would be realized and maintained if the body was normally fed and well nurtured with nature's wholesome non-poisonous products. If two persons, one temperate and 95 per cent. efficient, and the other a heavy, steady drinker, 85 per cent. efficient, were subjected to tests to determine the effect of moderate doses of alcohol upon their work (both muscular and mental), one would expect to see the highly efficient man, unused to alcohol, show a much greater falling off in efficiency during the period that alcohol was used, than the regular consumer whose system had established a condition of tolerance—although on a level below that of the abstainer functioning normally:

Subject	Habits	Average Efficiency	Efficiency after use of alcohol	Lessened Efficiency due to experiment
A	Abstainer	95	80	15
B	Drinker	85	85	0

Notwithstanding the lack of scientific thoroughness noticeable in most alcohol experiments, such investigations have great value; they clearly suggest the line of truth and therefore should prove helpful in the regulation of every-day habits.

Quensel has said that such experiments have clearly proved that work and drink do not go together, especially when the work demands alertness,

attention, exactness and industry, but this is no more than is taught by every-day experience and common sense. These investigations, it has also been said, prove that "alcohol reduces the ability to carry on mental work logically," but as Koren has written, this conclusion "is also something coming within the purview of ordinary observation."

### Alcohol and Athletics

Alcohol and athletics do not go together. The use of alcohol to-day by a college athlete, when in training, would be considered by his fellows as nothing short of insanity or treason. More than half of the players in professional baseball abstain from all alcoholic beverages, although no class of men are subjected to greater temptation. Connie Mack, Manager of the Philadelphia Athletics—the world's championship winner of 1910-1911 and 1913—said, "Alcohol is practically eliminated from baseball. A

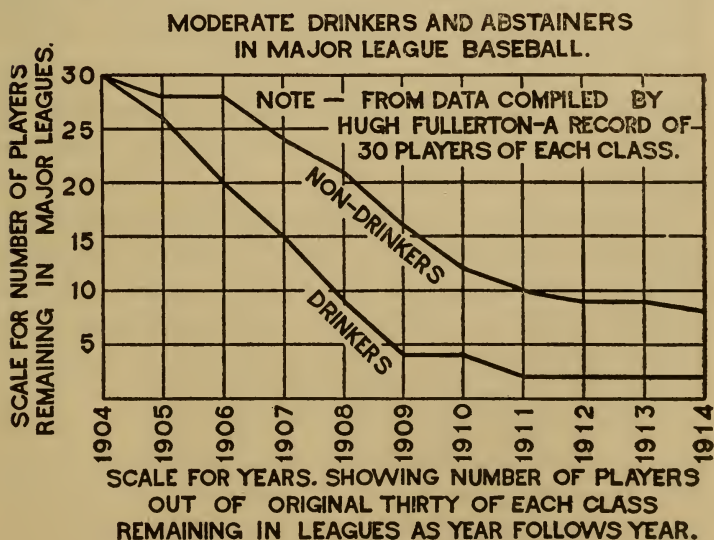


FIG. 26

big league player has to be in trim day in and day out or he is sent to the minors. It's the survival of the fittest."

The diagram on page 425 has been prepared, from figures compiled by Hugh Fullerton one of the leading baseball writers of the country, to show the survival of the non-alcoholic among the players of the National Game.

It is interesting to consider, comparatively, the careers of four great American pitchers who rose to prominence about the same time—Waddell, Raymond, Mathewson and Plank. The first two succumbed to alcoholism and dissipation while the latter two have always practiced sobriety. Waddell was one of the most talented men in baseball and in his prime was unbeatable. Raymond had wonderful physical ability but even a guardian escort, a human shadow in constant attendance, could not keep him going straight when off the diamond. Both are dead, ensnared and defeated by alcohol. Matty and Plank are still good and when their arms fail, their heads will carry them through to many victories and ultimately, in all probability, to executive leadership.

In the summer of 1908 a long distance championship walking match was held at Kiel, Germany, with 83 contestants, of whom 29 per cent. were abstainers and 71 per cent. non-abstainers. No athlete used alcoholic drinks immediately before or during the 62 mile walk. The first four winners were abstainers, and of the first ten prize-winners, 60 per cent. were abstainers; two of the remaining first ten (20 per cent.), though not general abstainers, had lived abstinent for months while in training for the event. The significance of the re-

sults consisted less in the winning of the abstainers than in the fact that 30 out of the 59 non-abstainers fell out by the way, whereas, of the 24 abstainers only two fell out. Of the 32 contestants who failed to reach the goal, 94 per cent. were non-abstainers and only 6 per cent. abstainers.

### **Brain Most Affected by Alcohol**

Physiological scientists discoursing on the effect of alcohol upon the human system, generally picture its deleterious action upon the stomach and the liver, but after all, it is the brain that is affected the most and the brain and nervous processes that suffer and are impaired the most, by the persistent or excessive use of alcohol. It has been said that the action induced by alcohol in the brain is of the nature of a progressive paralysis, beginning with the highest level and its most delicate functions and spreading gradually down through the lower. Moral qualities and the higher processes of intelligence are, therefore, first invaded. Sully-Prudhomme has said, "All in all, my opinion as to alcohol in all its forms is, that it is fitted, thanks to the devastation it brings about in the nervous system, to animalize people in all grades of society and sooner or later, to annihilate the superiority which man has slowly acquired over the anthropoid ape."

Vance Thompson says alcohol first attacks "those qualities so painfully acquired in the long years of evolution. It is the most delicate part of the mental machinery that is first impaired—that which has been most recently and fragilely built up in the evolution of character," and again he says, "You can drink and be sober on the physical level, but you cannot drink and be good, and you cannot drink

and be wise." But can one drink alcohol and be strictly sober on the physical level? If by "sober" we mean a physical condition where we are not detrimentally influenced by spirituous drinks, and if by "physical" level we refer to the activities of the physical body, excluding the moral judgments and higher intellectual mental functions, we are still forced to admit, as a result of unbiased research work, that alcohol does affect the physical and automatic, also elemental mentally controlled functions of the body as well as the morals and the higher intellectual mental processes. To be sober, one must be normally efficient and naturally self-controlled and self-possessed. Alcohol most assuredly does affect a man's complete nervous system, his muscles, his strength and endurance, and it also detrimentally influences all the parts of his wonderful brain, his emotions, imagination, higher intellectual powers and his moral qualities. It may be that the first impairment, as Thompson says, is moral, but the physical deterioration is promptly in evidence, and if every man who takes alcohol is as he says, "drunk at the top," we can with equal truth say he is, to a certain degree, "drunk" or poisoned throughout. Prof. Sikovsky, of Petrograd, has said, "Alcohol diminishes the rapidity of thought, makes the imagination and power of reflection commonplace and deprived of originality, acts upon fine and complex sensations by transforming them into coarse and elemental ones and upsets habits of work and perserverance," and Dr. Robert Jones asserts that, "Alcohol perverts the moral nature, affects the judgment and impairs the memory; it moreover especially affects the motor system and creates an enormous loss to the community through destroy-

ing the productiveness of skilled craftsmen." Alcohol has a strange affinity for all nerve matter and the brain is the headquarters of the nervous system. If this most sensitive nerve matter is poisoned, the generator, motors and all service wires are affected, the resistance to current flow increased and the efficiency of generation, transformation, transmission and distribution lessened. "You shouldn't be too hard upon a man who drinks," said Oliver Herford, "it is only a petty larceny he is guilty of anyway."

"O that men should put an enemy in  
their mouths to steal away their brains!  
That we should with joy, pleasure, revel and  
applause, transform ourselves into beasts!"  
—Shakespeare.

Prof. E. H. Starling said, "In the animal kingdom we find that there are two main factors which characterize rise in type and determine survival. These are control and co-ordination." Alcohol tends to weaken both and rob man of his birthright.

### **Poise and Dignity Affected by Alcohol**

Alcohol under certain conditions may increase sociability, for it is apt to cause loss of self-consciousness; it attacks the inhibitory centers and is the foe to reticence and reserve. It tends to lower the esthetic and intellectual ideal and it positively does not inspire the best wit and humor. Listeners influenced by the same narcotic agent as the speakers are "vinously exalted" and lose the sense of balance, proportion, faculty of discrimination and, at times, their normally accepted standard of propriety. Such a man may be applauded vigor-

ously, be keyed up to an amazing degree of enthusiasm and laugh uproariously at jokes that his neighbor—with glass turned down—rightfully thinks inane, stupid and possibly in bad taste. Alcohol tends to make a man mistake words for thoughts; it usually makes a poor speaker for an intelligent audience, and a lenient or even enthusiastic audience for a poor speaker.

Alcohol has ruined the future of many a man holding a position of confidence and trust, for it unlocks the door of the mind's secret chambers, eliminates the mental guardian and encourages babbling. No man can keep personal or business secrets perpetually if he drink alcohol to excess and is in the company of capable "pumpers." The papers to-day (April, 1916) tell of a man who committed homicide in New York nine years ago, escaped and became a total abstainer from alcohol. Yesterday he became intoxicated, boasted of his exploits while under the tongue-loosening effects of alcohol, and to-day he is in jail. He could keep his secret for nine years sober, but he couldn't guard it for many hours when drunk.

The drinking of alcohol for sociability and pleasurable-ness has been aptly termed "drugging for delectation," but there is something wrong with a man whose nervous system needs deadening before he can feel happy and in harmony with life and his fellows. No man should be content with any measure of health that does not insure happiness and sociability without drugs and the aid of a narcotic. Solomon said, "Give wine to him that is ready to perish that he may drink and forget his misery." Alcohol is an intellectual depressant; it does not give courage to meet failure and overcome

adversity, but it deadens consciousness and obliterates facts from the mind; the cause remains and the misery returns, intensified by mental and nervous depression as the reflex action of drugs—inspired forgetfulness. Alcohol tends to befog the mind, to lessen true mental vision and warp one's sense of proportion. It clouds the imagination and the perceptions become dulled and blunt by the "mist of intoxication."

### **Medicinal Use of Alcohol**

Metzer has said that "Alcohol in health is mostly a curse, and in sickness mostly a blessing." To a limited extent alcohol administered in very small quantities may act as a food or substitute for non-nitrogenous foods. Alcohol is absorbed into the circulatory system direct from the stomach and its fattening effects in moderate drinking are well known. It is most probable, however, that a very small dose of alcohol on an empty stomach has an appetizing effect and this is one of its merits in illness, although it must be borne in mind that alcohol requires no digestion and throws no work upon the digestive glands, and a small quantity can, therefore, be tolerated and absorbed when many other foods would remain undigested. Dr. Carroll Smith, of Boston, is a firm believer in the use of alcohol medicinally. He decries the modern crusade which sees only vice in things, which used in moderation and pathologically, may possess much virtue. "Much of the crusade against the use of alcohol in every disease is due in the one case to the spirit of the iconoclast, and in the other to the want of experience, while still other conscientious physicians seem to move more readily in the line of the least

resistance.” The presidents of the State Medical Societies and Faculties of our Medical Colleges were recently addressed in regard to their opinion of Alcohol and almost without exception they seemed to agree that alcohol is useful medicinally. The use of alcohol is fraught with so much danger. however, that even in illness it is not being used as much as formerly, but its use pathologically is still great and no law should, directly or indirectly, prohibit its use in the home and by people of mature age.

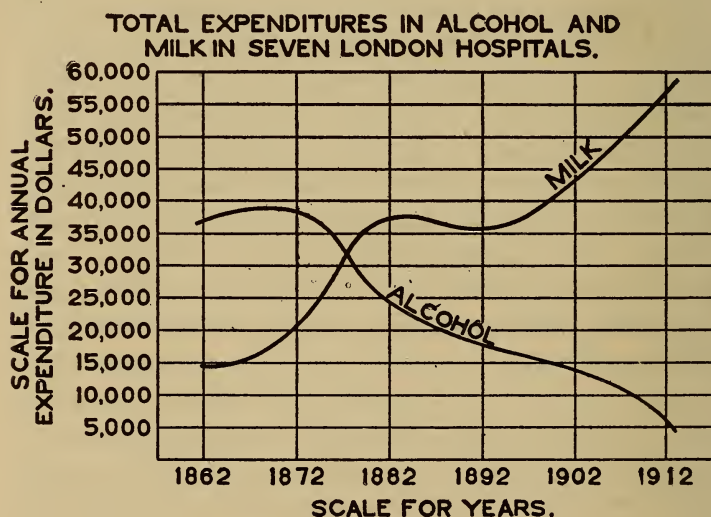


FIG. 27

Medical authorities unanimously agree that the use of alcohol predisposes the user to diseases of the kidneys, liver and heart; it exerts an injurious influence upon the nervous system and tissue vitality as a whole. “Liver disorders,” said Dr. J. M. Whyte, “are probably in all cases prejudicially influenced by alcoholic beverages. In kidney diseases

alcohol should be withheld, for alcohol in moderate quantities irritates the kidneys."

The excessive, habitual previous use of alcohol positively lessens the chance of recovery in a case of pneumonia and it is one of the prime causes of arteriosclerosis—hardening of the arteries—a disease which makes a young man prematurely old.

Horsley and Sturge have compiled some interesting figures to show the pronounced decline in the

**EXPENDITURE IN ALCOHOL (CENTS PER PATIENT)  
LONDON METROPOLITAN FEVER HOSPITALS.**

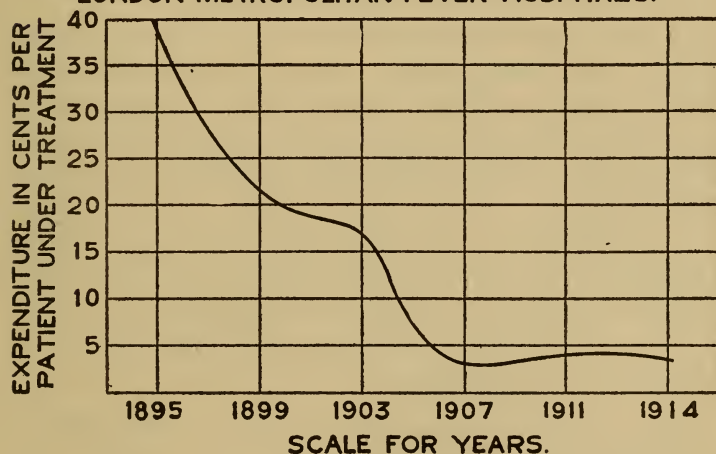


FIG. 28

consumption of alcohol in British hospitals during the past half century, and with the reduction in the use of alcohol, the increased consumption of Milk is most pronounced. The accompanying diagrams show graphically the Total Annual Expenditure on Alcohol and Milk during certain years, as indicated, in seven leading London hospitals—the average number of beds occupied being 2,336, and this number held constant, i. e., within four per cent.

The annual expenditure for alcoholic liquors, per patient, in the Massachusetts General Hospital was reduced 71 per cent. during the decade ending 1906, and during the same period the consumption of drugs in general decreased 45 per cent. In 1897 the Hospital expended 46 cents per patient for alcohol, and in 1906 this expenditure had been reduced to 13 cents. Dr. Cabot has said, "It indicates a rapid and striking change on the part of the physicians or the general staff since it became known that alcohol is not a stimulant but a narcotic."

Of late years the use of Alcohol in the treatment of fever has been greatly reduced, and the accompanying diagram shows graphically the expenditure on alcoholic beverages, per patient, in the London Metropolitan Fever Hospitals during the period 1895-1914.

A pronounced revolution has also taken place during the past few decades, in the use of alcohol for the treatment of insanity. The following statistics from the Asylum's Committee of the County of London are of interest:

	1889	1905-1906
Number of persons,	8,107	19,457
Consumption of Spirits—gal.	1,066	218
"    "    Wine    "	836	33
"    "    Beer    "	255,486	1,282
Total consumption of		
Alcoholic Beverages—gal.	257,388	1,533
Average consumption		
per person:		
Spirits — gal.	.131	.011
Wine    "	.103	.002
Beer    "	31.514	.065
Total    "	31.748	.078

**Much Insanity Caused by Alcohol**

*The Lancet* of May, 1889, said, "During the years 1861-5 there entered the Asylums of France 14,983 insane persons. In the same space of time twenty years later there entered more than 57,000." Dr. Serieux investigating into causes found that "of the relapsed cases 78 per cent. were drinkers, while of the violent lunatics 88 per cent. were drinkers." In 1903, Sir T. Clouston of the British Morningside Hospital said, "This year no less than 42.3 per cent. of all our men and 18 per cent. of our women—much the largest proportion we have ever experienced—had excess in alcohol assigned as the cause of their insanity. In the five years 1873-7; the percentage of alcohol cases was only 18.5 among the men and 10.4 among the women admissions," and he added, "It is certain that for every man in whom excessive drinking causes absolute insanity there are twenty in whom it injures the brain, blunts the moral sense and lessens the capacity for work in lesser degrees."

In the United States it is estimated by different authorities that on the average from 20 to 30 per cent. of all insane patients admitted to asylums each year, owe their condition wholly or partly to alcohol, and that it costs \$5,332,000 every year to care for the American alcoholic insane. In the New York State Hospitals in 1910, alcoholic habits were reported in 60 per cent. of the men and 20 per cent. of the women among the 5,245 patients admitted for the first time, from whom positive statements concerning the use of alcohol were secured. Alcoholic insanity, as such, appeared in 15.7 per cent. of the men and in 3.9 per cent. of the women. In Norristown, Pa., State Hospital for the Insane, Dr. Mc-

Kinness tells us that of 520 new male patients in two years, alcoholism was a factor in 46 per cent. of the cases. Stoddard says, "Taking statistics from various countries it would appear that at a conservative estimate about one case in every four of insanity (25 per cent.) is chargeable directly or indirectly to drink."

Doctor Emil Muensterberg of Germany, in "Alcoholism and Poor Relief," with reference to Alcoholism and Insanity and the Breaking up of Homes, says:

"The consumption of alcohol in Germany is exceptionally great. Fifty thousand insane are in German asylums yearly whose sickness can be traced back to alcohol. Out of years-long experience I can say that in almost no case is the break-up of families due to any other cause than to drink and looseness."

### **Effect of Alcohol on Digestion**

Alcohol when present in considerable quantity has, as is well known, a hardening or coagulating (precipitating) effect upon a great many tissues and substances. Its use as a hardening and preserving agent is well known. When present in the normal stomach in the proportion of 10 per cent. or more, it causes delay in peptic digestion and digestion is retarded as the percentage of alcohol is increased. The accompanying diagram and table prepared from data obtained from the interesting investigation of Sir William Roberts show that Sherry Wine is more injurious than spirits in its impediment to natural digestive processes.

A small quantity of alcohol may be used medicinally to encourage and stimulate the flow of gastric digestive juices; but if such flow is normal and the

stomach healthy, it is evident that all alcoholic liquors have a tendency to delay digestive processes. The retarding effect of malt liquors is, as with wine, altogether out of proportion to their

DIAGRAM TO SHOW THE RETARDING EFFECTS OF ALCOHOL UPON DIGESTION.

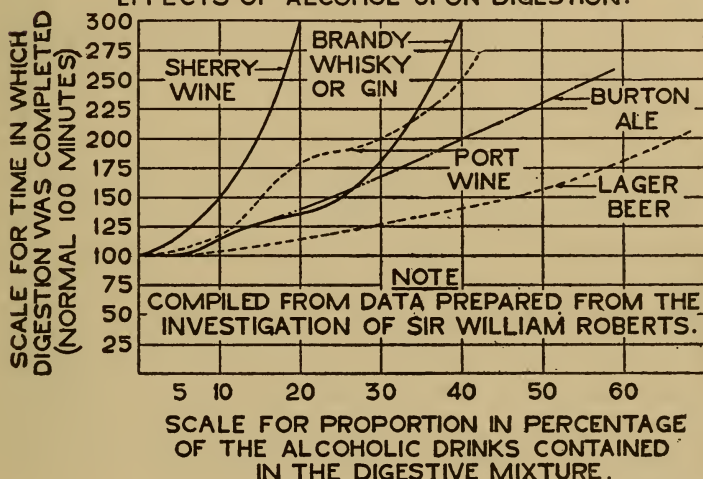


FIG. 29

A TABLE SHOWING THE RETARDING EFFECT OF ALCOHOL UPON DIGESTION.

(INVESTIGATION OF SIR WILLIAM ROBERTS.)

PROPORTION OF THE ALCOHOLIC DRINK CONTAINED IN THE DIGESTIVE MIXTURE	BRANDY WHISKY OR GIN	SHERRY WINE	PORT WINE	BURTON ALE	LAGER BEER
5 Per Cent	MINUTES 100	MINUTES 115	MINUTES 100	MINUTES 108	MINUTES 100
10 " "	115	150	115	115	100
15 " "	125	200	150	125	108
20 " "	135	300	180	140	115
30 " "	180	Embarrassed	200	165	130
40 " "	300	None	Embarrassed	200	140
60 " "	Embarrassed	None	None	Embarrassed	180

FIG. 30

alcoholic content. Roberts also proves that tea and coffee retarded gastric digestion and summed up his research with the statement that "with the single and trifling exception of carbonated water I found that none of the various accessories which we use with food, aided peptic digestion."

As is well known alcohol is a preservative and, therefore, when present in quantity in any receptacle, including the human stomach, resists change of vegetable or animal matter and chemical changes are necessary if digestion is to take place.

Dr. Chittenden of Yale has found that when the percentage of alcohol in the digestive mixture is as low as 2 per cent. in the healthy stomach there is sometimes a slight acceleration of the rate of digestion, but as the percentage of alcohol is raised, retardation or inhibition becomes more noticeable, although ordinarily it is not very pronounced until the digestive mixture contains 5 to 10 per cent. of absolute alcohol.

#### **Alcohol as a Cure for Colds**

Alcohol is used with some success to "break up" incipient colds. Stiles says that "its influence upon the distribution of the blood is not unlike that of quinine. It causes a flushing of the skin, accompanied by the subjective impression of warmth." A person taking alcohol for a cold should do so after and not during exposure and great care should be taken not to catch more cold as the body is weakened by the rush of blood to the skin, a sign that heat and energy is passing from the body into its surroundings. The use of alcohol during exposure is unwise; the habitual use of alcohol to "ward off colds" is foolish for such a practice lessens bodily

resistance. A hot lemonade with alcohol, followed by a long sleep, well wrapped up in bed, free from drafts and exposure will tend to "break up" a newly acquired cold, but care must be taken to have the pores of the skin normally closed and the vitality raised by food before subjecting the body once more to conditions favorable to the acquiring of more cold. Alcohol in such treatment should be considered as a powerful, weakening narcotic, and not as a pleasurable stimulant. Conformity to nature's laws would prevent the phenomenon known as "catching cold." Colds are one of the curses of civilization with its indoor life, polluted air and artificial heat; people who live natural out-of-door lives, never catch cold. To prevent colds one should therefore breathe deeply of good, pure air and when chilled breathe more deeply; open the boiler draft, liven up the internal fire, accelerate the blood flow and the threatening cold is vanquished. A little exercise, a brisk walk, a run, a hot bath, all act to throw off a forming cold, if care is taken not to stand inactive or in a draft after physical exertion and when the body is perspiring.

### **Intoxication Analogous to Insanity**

Intoxication does not necessarily mean only obvious and palpable drunkenness. Dr. Hyslop has truly said, "From the very moment in which alcohol has disturbed the healthy exercise of the mental functions or has impaired the moral sense by unduly exciting the animal passions or has in any way unfitted a person for discharging his duties in the proper struggle for survival, from that moment has there been a guilt of intemperance." It has been said that intoxication epitomizes the

whole history of insanity. The man who becomes dead drunk within the space of a few hours undergoes very much the same change as the man who becomes gradually insane, and he who keeps his association and motor senses slightly drugged all the time by "moderate" drinking is not entirely a "sane" man. He is constantly drunk to a slight degree and is, therefore, constantly insane to a slight degree.

#### **Alcohol Even in Moderation not Conducive to Health**

For many long years the moderate use of alcohol was considered with favor by the medical profession and insurance authorities. Anstie's standard or "Anstie's limit" was quoted and preached. The moderate drinker was held in high esteem and total abstinence was considered decidedly fanatical. According to Anstie the correct quantity of alcohol per person per day could be represented by any one of the following: three ounces of spirits; two wine glasses of heavy port wine; one pint of claret, champagne or similar still or effervescent wine; three tumblers of heavy ale or porter; or four to five glasses of light ale or beer. We are now informed by the Medico-Actuary and Scientist that Anstie's limit belongs to the Dark Ages of Medical, physiological and psychological knowledge, and to a period of ignorance and indifference when, in the words of Bernard Shaw, "Society was organized to suit boozy people."

Seventy-six years ago (1840) the management of a British Life Insurance Company received an application for a policy from a man who stated that he was a total abstainer from alcoholic drinks—a teetotaler. After consultation, the Directors of the Insurance Company decided that they would grant

the insurance requested, but only on the basis of a 10 per cent. increase over the standard premium rates because, they ruled, "The applicant is of a thin and watery disposition and mentally cranked in that he repudiates the good creatures of God as found in alcoholic drinks." It is interesting to know that this Quaker abstainer, branded as fanatical and a bad "life risk" by the Medico-Actuaries of his time, lived to be 82. To-day all Life Insurance Companies prefer total abstainers to those who use alcoholic drinks even in moderation. The world's opinion of alcohol has certainly changed since the days of our grandfathers.

American Life Insurance Companies' Comparative Mortality Statistics, covering 43 Companies for a period of 23 years, show the following interesting figures in regard to the users of alcohol:

Death rate among insured lives generally.....	1.
Death rate among policy holders (moderate drinkers)	1.18
Death rate among policy holders (with history of past intemperance) .....	1.50
Death rate among policy holders (steady drinkers accepted, however, as standard risks).....	1.86

Deaths among drinkers from Bright's Disease, kidney trouble, degeneration of the arteries, pneumonia, etc., were far above the average.

The New England Mutual Life Insurance Company recently prepared the following table, based on figures taken from 180,000 insurance policies covering a period of 60 years:

Expected mortality,	100 per cent.
Actual mortality—moderate drinker,	125 " "
" " temperate drinker,	84 " "
" " rare drinker,	71 " "
" " total abstainer,	59 " "

A British Insurance Statistical Table, giving the record of 45 years' experience, shows:

Expected mortality,	100 per cent.
Actual mortality—non-abstainer,	91.27 “ “
“ “ abstainer,	66.25 “ “

In other words, of 100,000 abstainers 33,750 would still be living at the end of 45 years, while of 100,000 drinkers but 8,730, or about one-fourth as many, would be alive at the end of that period.

A diagram prepared by Sir Victor Horsley, Physician to Queen Victoria, compiled from insurance reports, shows that of 100,000 ordinary persons 30 years old, 44,000 reach the age of 70 years, while of 100,000 abstainers 30 years old, 55,000, or 25 per cent. more, reach the age of 70 years.

#### **Alcohol Decreases Resistance to Disease**

Alcohol not only shortens life, but it mars the efficiency and earning power of the individual while he lives. It lowers the bodily tone and this is manifested both by increased liability to contract disease and by the greater severity of the disease. As Somers says, “Our resistance not only keeps off the enemy but defeats him if he has by any chance effected a landing.” During the cholera epidemic of Glasgow, Adams found the death rate among drinkers 91.2 and among abstainers 19.2 per cent. Hoppe says that 92 per cent. of the inmates of the Sanatoria for Consumptives at Loslav were drinkers, and Bertillon and Vallows state that their investigations indicate that 33.33 per cent. of male consumptives were heavy drinkers, 40.17 per cent. moderate drinkers and 26.5 per cent. claimed teetotalers, the percentage of drinkers to non-drinkers

being very much larger in consumptives than in the corresponding normal population.

At the International Congress on Tuberculosis, which met in Paris in 1905, the following resolution was passed, and has been confirmed at each Convention since, including Rome in 1913: "That in view of the close connection between Alcoholism and Tuberculosis, this Congress strongly emphasizes the importance of combining the fight against Tuberculosis with the struggle against Alcoholism." At the Henry Phipps Institute in Philadelphia, records were kept for several years on the relation between Alcoholic habits and the response to treatment for Tuberculosis. The following synopsis of these investigations is of interest:

	Temperate and Abstainers Per cent.	Alcoholic Per cent.
No. of Patients benefitted by treatment,	49.2	29.5
No. of Deaths,	9.9	21.8
No. of Patients not benefitted by treatment,	40.7	48.5

Drs. Osler and McCrea have prepared statistics to show that in pneumonia, the disease on the average is much more likely to progress unfavorably if the sick person is an excessive or habitual user of alcohol. Their statistics show that 18.5 per cent. of pneumonia patients who were abstainers died from the disease; 25 per cent. of those who were moderate drinkers and 52.8 per cent. of those who were immoderate drinkers and positively alcoholic.

The sickness and mortality record of the Leipzig Sick Benefit Clubs show that whereas the number of deaths in the general class can be represented as

100, the proportional number of deaths in chronic alcoholics for each 100 in the general class is as follows:

All Diseases,	293
Diseases Nervous System,	267
“ Respiratory System,	667
“ Circulatory System	137
“ Digestive System,	267
Wounds,	300

All men studied were in the prime of life.

Dr. Welch, of Johns Hopkins University, has said, “In one way or another most of the organs and tissues of the body may become the seat of morbid changes chargeable to the poisonous action of alcohol.” Dr. Lambert, of the Bellevue Hospital, New York, has reported the organic changes in alcoholic men and women—chronic drinkers—whose deaths occurred at the Hospital:

	Men	Women
	Per cent.	Per cent.
Heart Disease,	90	90
Hob-nailed Liver,	48	34
Fatty degeneration of Liver,	80	74
Chronic inflammation of Stomach,	50	50

These studies also showed affections of the blood-vessels, lungs, spleen, pancreas, kidneys, nervous system, etc. Lambert has said that with some heavy drinkers “there is for years no apparent lesion and when some sudden strain on the organism occurs, its equilibrium is upset and the whole organism crumbles.”

Surgeons maintain that their work is hindered and hampered by the alcoholic habits of patients, for the healing of wounds is positively delayed by

alcohol. Sick Benefit Insurance bodies "fight shy" of the excessive or habitual users of alcohol. Statistics from Leipzig, Germany, show that for every 100 non-drinkers sick between the ages of 15 and 74 there were 263 drinkers sick. Australian figures for leading Friendly Insurance and Sick Benefit Societies reported by Gouge are:

	Temperate	Drinker
Average number of weeks' sickness per member,	1.2	2.3
Average number of weeks' sickness for each person ill,	6.45	10.91
Mortality—expressed in percentage,	.68	1.38

In addition to physical illness and organic ailments, there is, of course, a larger number of alcoholics than abstainers constantly suffering from the effects of accidents.

### Mortality in Relation to Occupation

Some interesting statistics have been prepared by the British Registrar-General to show the comparative mortality from various occupations. It is certainly not due to chance and blind coincidence that for two periods a decade apart, the handlers of alcoholic beverages showed such high relative mortality:

Occupation	Years 1890-1892	Years 1900-1902
Gardeners,	568	527
Teachers,	571	599
Grocers,	664	670
Doctors,	957	952
Brewers,	1,407	1,324
Inn Keepers and Inn Servants,	1,665	1,669

Comparing the employes of British Inns with all occupied males, we find that out of a given number in each group, among Inn and Saloon employes

	8	times	as	many	die	from	Alcoholism,
5.5	"	"	"	"	"	"	Gout,
1.3	"	"	"	"	"	"	Diseases of Nervous System,
1.8	"	"	"	"	"	"	Suicide,
2.5	"	"	"	"	"	"	Consumption,

as the average for all occupied males in every trade, profession and gainful pursuit.

The Prudential Insurance Co. has prepared tables based on the records of 103,434 deaths of occupied men over 15 years of age in the Company's industrial experience during the period 1907-1910. The statistics tabulated show the proportion of deaths due to various diseases out of the total number of deaths in each occupation. For example, out of 1,163 bartenders who died, 78, or 6.7 per cent, died of alcoholism—as a *prime* cause, not as a contributory factor. This “proportionate mortality” rate is of value in showing what are the causes of death operating in different occupations and at different periods of life. The average number of deaths due solely to alcoholism in 20 occupations was 1.5 per cent. and of the occupations recorded, it is interesting to note that saloon-keepers had 4.4 per cent. of such deaths, glass-workers, plumbers and masons 1.9 per cent. and printers 1.6 per cent. Between the ages of 25 and 44, the percentage of deaths occurring in all occupations was 31.7; of saloon-keepers 48 per cent. died in this age period, and of bartenders 72 per cent.

### Mortality Due to Alcohol

Dr. T. D. Crothers says, "The latest and most authentic statistics show that over 10 per cent. of all mortality is due to the *abuse* of alcohol, and fully 20 per cent. of all disease is traceable to this cause; also that over 50 per cent. of insanity, idiocy and pauperism spring from this source. All authorities agree that from 75 to 90 per cent. of all criminality is caused by the *abuse* of alcohol. These and other well authenticated facts indicate the necessity of a more exact medical study of alcohol and its effects and influences on society and the individual."

Statistics show that the deaths from Alcoholism or acute alcoholic poisoning in the Federal registration area of 18 states, in 1912, numbered 3,183, but only a very small percentage of the total number of deaths due to alcohol is officially attributed to alcohol, whose greatest work of destruction is performed in a more subtle and less spectacular way than by alcoholic delirium tremens. Alcohol taken habitually or to excess attacks the nerves, stomach, liver, kidneys and heart, and creates a condition favorable for diseases of the respiratory system—consumption, pneumonia, etc.; it also tends to lower the body tone and its resistance to infection. It causes the condition of old age in a young man and a large percentage of the deaths attributed to the liver, kidneys and circulatory system have been caused by alcohol, and many other fatalities are indirectly induced by it. The statistics of the British Registrar-General indicate that during the year 1903, 1,475 deaths of males and 1,075 deaths of females were returned as caused by alcoholism. Horsley and Sturge commenting on these reports,

say "For obvious reasons, the number of deaths registered under this head are greatly underestimated. The Doctor in attendance hands the death certificate to the nearest relative of the deceased and he is careful not to hurt the relative's feelings." In the same British Mortality Statistics 3,916 deaths are attributed to cirrhosis of the liver, a disease known to be very often due to alcoholic indulgence. In Switzerland the introduction of the confidential death certificate immediately revealed the existence of an incredible amount of slow alcoholic poisoning among the people.

E. B. Phelps, author of "The Mortality of Alcohol," estimates that 65,897 deaths occur in this country annually, in which alcohol is a causative or contributing factor.

#### **Inefficiency Caused by Alcohol**

Drunkenness is an abomination, a condition lower than that ever reached voluntarily by any beast. Immoderate or habitual drinking of alcohol, even if it does not lead to apparent drunkenness, nevertheless intoxicates and is harmful to the system and antagonistic to mental and physical efficiency. It has been said that for every real and apparent drunkard there are fifty others suffering from the deleterious effects of alcohol. Temperance is a virtue. Abstinence in regard to some poisons may be a greater virtue, but temperance or abstinence in regard to the use of alcohol in any form is necessary for efficiency and maintained health. "Work and alcohol," said Quensel, "do not belong together, especially when work demands wide-awakeness, attention, exactness and endurance."

### Alcohol and Accidents

Statistics also prove that alcoholism is a prolific cause of accidents, and in Zurich, records kept in the building trades for seven years indicated that the day after a Sunday or a holiday, accidents had averaged 42 per cent. increase, due to the effect of alcoholic dissipation during the non-working day and the effect on steadiness of nerve action and judgment the day after.

The following diagram has been made from the studies of Ulbrecht of Dresden during 1894 and 1895 and these investigations also show that Monday, or the day following a holiday, is the most prolific in accidents. The number of accidents on Monday was 53 per cent. more than on Wednesday, the best day of the week, and Sundays and holidays

DIAGRAM MADE FROM THE INVESTIGATIONS OF ULBRECHT OF DRESDEN GIVING THE PERCENTAGE OF ACCIDENTS OCCURRING ON EACH DAY OF THE WEEK

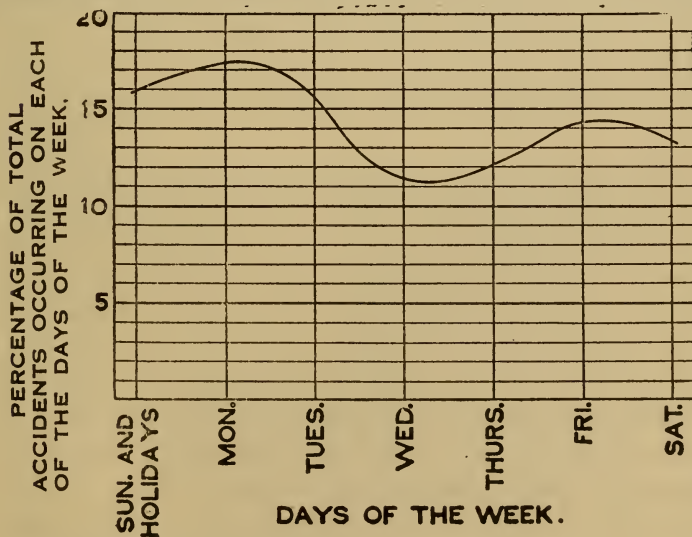


FIG. 31.

—non-working days—had 40 per cent. more accidents than the best working day of the week.

Dr. Miller has said that during the period covered by his records, the average number of accidents per day in Edinburgh, Scotland, was 5.65 and during Saturday and Saturday night it was 10.26. During Saturday night it was 6.08 and during the other nights only 0.9, the great difference being attributed to alcohol and drinking after pay day. Statistics compiled in Belgium indicate that 43 per cent. of all accidents in the mines and factories of that country were attributed to the excessive use of alcohol.

German statistics have shown the association of alcohol with accidents. Investigations have shown that alcohol tends to:

1. Dull senses and alertness in perceiving danger,
2. Impair judgment of distances and thus of danger,
3. Impair ability to decide quickly and accurately how to avoid danger,
4. May cause unsteadiness of hand or foot and physical instability.

The Leipzig Sick Benefit Club report, covering workers representing 952,674 insurance years, that at all age periods the workers in whom Physicians saw the effect of alcoholism, had from two to three times as many accidents as the average workman. The records of these Clubs give some interesting statistics covering the illness and mortality between "average" men and the men classed as drinkers—those in which the Physicians were able to detect some physical effects of alcoholism.

At the age period of 25-34 years, for every 1,000 insured years, the average number of cases of sick-

ness was 368, but the drinker had 973 or 2.64 times the average. At the age period of 35-44, the drinker had 2.83 times as many cases of sickness as the average, 2.6 times for the age period 45-64 and 2.93 times for 65 and over. The duration of sickness was as follows:

Age Period	Average Men	Alcoholics
Years	Days	Days
25-34	7.53	19.29
35-44	10.03	27.13
45-54	13.29	33.32
55-64	18.38	40.79
65-74	29.52	76.84

These figures show the increase in illness due to age and the increase of illness caused by alcohol undermining the system. At every age period Alcoholics lost about  $2\frac{1}{2}$  times as much working time as the average man—an increase of suffering, loss of income and economic loss to the family and state. The mortality figure for every 10,000 insurance years given in the Leipzig statistics are as follows:

Age Period, Years	Average Men	Alcoholics
25-34	53	122
35-44	97	284
45-54	167	372
55-64	298	364
65-74	580	746

Death, therefore, carried off in the prime of life from 2 to 3 times as many men addicted to the excessive or habitual use of alcohol as other average insured men.

The Steel Works at Volklingen, Germany, found

that their temperate employes averaged 8 accidents per 1,000 men, while the general rate in the Works was 12 per 1,000.

The responsibility of the workman toward his fellows is indicated in the statement recently issued by the Fidelity and Casualty Accident Insurance Co.

"A man whose nerves have been made unsteady by a recent debauch or by the habitual use of alcohol should not be permitted to operate dangerous machinery or to carry on dangerous work. *He endangers not only his own life, but the life of others.*"

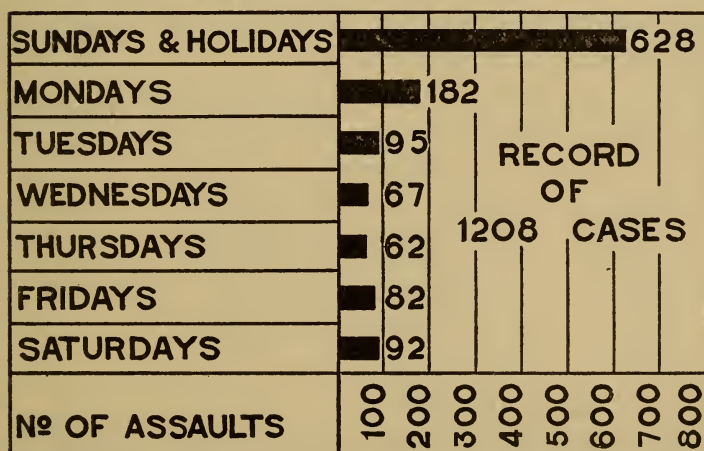
### Alcohol and Crime

Kürz has prepared some interesting figures as a result of German investigations bearing upon the prolificness of bodily injuries arising from the use of alcohol and absence from work. His figures refer to injuries sustained from assaults and should not be confused with records of accidents. The following chart shows that considering the average week-day cases of bodily injuries, other than Monday, as 1, then the average number of injuries on Monday is 2.28 and on Sundays and holidays 7.85. Of the total number of arrests for assault 66.5 per cent. were made in saloons, but many assaults committed outside drinking houses were also attributed to the excessive use of alcohol. It has been said, "The sober man thinks before he acts. Alcohol makes a man act before he thinks." Alcohol often causes irritability and weakens the judgment and self-control needed to hold irritability in check.

Judge Rentoul, of Great Britain, has said, "Several of our greatest Judges have stated that 90 per cent. of all the crime they have tried arises from

drink. I can say exactly the same—but I have found the evils arising from drink greater in the civil than in the criminal courts. The unhappiness, poverty, hatred and ill-will arising from the amount of money spent by some members of the family are worse in their effects than actual crime, and I speak with equal experience in both courts.”

**CHART OF BODILY INJURIES  
ON DIFFERENT DAYS OF THE WEEK.**



**CHART OF WHERE ARRESTS WERE MADE**

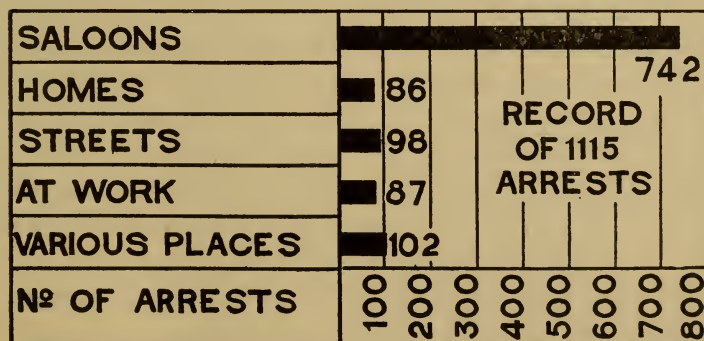


FIG. 32

Of 269 murderers, committed to Wisconsin State Penitentiary at Waupun in recent years, the authorities report:

41.5	per cent.	used alcohol to excess,
27.9	“ “	had previously been arrested for drunkenness,
12.6	“ “	did not use alcohol.

Records made in Sweden between 1887 and 1905 showed that of the men prisoners 71.9 per cent. were either intoxicated when the crime was committed, or were habitual drinkers. The influence of alcohol was proved as follows:

In	86.5	per cent.	of breaches of public order and regulation,
	85.2	“ “	of assassinations, murders and physical violence,
	82.3	“ “	of robbery with violence,
	71.2	“ “	of breaches of military law,
	68.3	“ “	of thefts and larcenies,
	66.9	“ “	of sexual crime,
	38.8	“ “	of swindling,
	34.6	“ “	of perjury,
	33.0	“ “	of libel.

Investigations conducted in the state of Massachusetts show that of the 155,487 persons arrested in 1912, 98,651, or 63.4 per cent., were arrested for drunkenness. The report of the Board of Prison Commissioners commenting on these and other kindred statistics, says, "The abuse of alcohol, directly or indirectly, does more to fill our prisons, insane hospitals, institutions for the feeble-minded and alms-houses than all other causes combined. . . . Ninety-five per cent. of all prisoners committed to Massachusetts prisons were of intemperate habits."

The Criminal Statistics of England and Wales

for 1913 report that, "The number of persons tried for indictable offenses were 63,269 and for non-indictable offenses 680,290. Of these 204,038 were cases of drunkenness."

The Committee of Fifty, with Hon. Seth Low, of Columbia University, as Chairman, found that in more than 12,000 cases investigated, the excessive consumption of alcoholic liquors was responsible for 49.9 per cent. of the crimes committed.

The various influences that caused the breaking up of homes in Chicago were tabulated from the official records in 1913 by Judge Gemmill of the Court of Domestic Relations:

	Per cent.
Drink,	46
Immorality,	14
Disease,	12
Ill temper and abuse,	11
Intemperance of parents,	7
Miscellaneous causes,	10
	<hr/> 100

An investigation conducted in 1914 by the Brooklyn Court of Domestic Relations indicated that 48.5 per cent. of family separations could be attributed to alcohol—economic and moral.

The U. S. Census Reports indicate that for a period covering 20 years, alcohol was a cause in 19.5 per cent. of divorces and the sole cause of 7.9 per cent. When divorces were granted to the wife, the husband was intemperate in 26.3 per cent. of the cases; of the divorces granted to wives for neglect, the husband was intemperate in 21.2 per cent. of the cases, and in one divorce in every three granted to the wife for the husband's cruelty, he was intemperate.

**Alcoholism and Suicide**

The connection between Alcoholism and Suicide has been commented upon by Prof. Hillier, of Kiel, who reported autopsies on 300 suicides, and found that 48 per cent. were pronounced alcoholists. The following table shows that 73.6 per cent. of the male suicides over 30 years of age were addicted to excessive alcoholism.

	No. of Alcoholists		No. of Alcoholists			
	Males	No. %	Females	No. %		
Under 30 years,	63	14 22.2	41	1 2.4		
Over 30 years,	167	123 73.6	29	6 20.7		
	<hr/>	<hr/>	<hr/>	<hr/>		
Total,	230	137 59.5	70	7 10.0		

Dr. Sullivan, of the British Prison Service, says that alcoholic suicide is more impulsive than other forms and states that in 220 consecutive observations he found that 78 per cent. of suicidal attempts were due to alcoholism.

The Census Bureau Mortality Reports show that during the years 1901 to 1910 there were 62,660 persons in the United States who committed suicide, and it has been said that 14,411 of these cases of self-destruction, or 23 per cent., can be attributed directly or indirectly to the excessive use of alcohol.

**Canteen System in Industry**

We have heard a good deal from Germany about Alcoholism in Industry and during the past two decades much has been done to enhance efficiency by endeavoring to curtail the use of alcohol by the workers. The alcoholic canteen system in Germany is in its essence opposed to health and efficiency, but the German method of endeavoring to curtail the use of alcohol by the substitution of tea, may in-

crease the immediate efficiency of the workers in the shops—if the substitution is effected—but it is very doubtful as to whether it would improve the health of the men. The inauguration of the tea canteen at the Berlin General Electric Works has been said to have reduced the abuse of alcoholism, but an analysis of the figures presented to substantiate this statement shows that the consumption of alcohol has remained practically constant, whereas in one year the consumption of tea has increased 50 per cent. To the alcoholic evil has, therefore, been added a caffeine and tannin drug evil, and it is interesting to note that whereas, in January, 1909, 6.4 drinks of tea were sold on the average to each employee, in January, 1910, the number had increased to 14.5; in January, 1911, it was 19.4, and in June, 1911—the last month for which figures are available—it was 28.5.

DIAGRAM SHOWING THE EXPERIENCE OF THE BERLIN GENERAL ELECTRIC SOCIETY WITH A TEA CANTEEN IN ADDITION TO THEIR ALCOHOLIC CANTEEN.

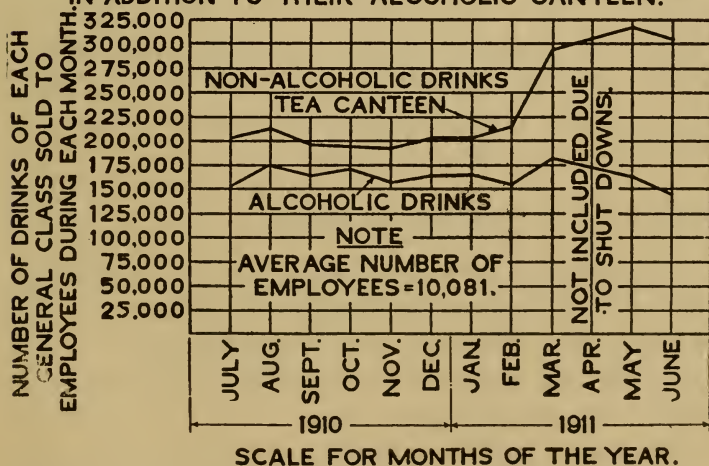


FIG. 33.

The diagram on page 457 has been prepared to show graphically the Alcohol and Tea consumption in the Berlin General Electric Societies Works for a period of one year.

Other European manufacturing establishments have reported on the efficiency of the tea canteen as a substitute for alcohol, but their figures are not truly comparative. A crusade by employers against alcohol will naturally reduce the consumption of alcoholic beverages within the shops whether tea is sold to the men or not. No industrial plant or manufacturing establishment should, under any condition, sell alcoholic beverages to their workers, permit the use of such drinks within the plant, or sell or give to the employes any drugged drinks during working hours. The solution of the drinking evil in manufacturing plants lies in supplying the workers at or near their work, with good, pure and cool, fresh drinking water. At meal times hot coffee or weak tea, preferably the former, could be supplied if desired, but the use of drugged drinks should be limited to meal times, and pure, refreshing, running water supplied by sanitary fountains should be available at all times.

### **Habit-forming Tendencies of Alcohol**

An unbiased investigation of available facts and general observation demonstrate conclusively that alcohol used habitually even in moderation, or occasionally to excess, is positively detrimental to health and possibly to morals.

Tippling, which is habitual, and drunkenness, which is dissipation, are inefficient and therefore

should be avoided as they mar body and mind and lower the standard of one's work.

The occasional use of alcohol for pathological purposes may be warranted but it is a pronounced habit-forming poison and should be let alone by those who do not need it and who may not be able, because of appetite, to control their desire for it. The poem of M. T. Higginson refers with subtle truth to the dormant appetite or hereditary tendency within some men:

"We wondered why he always turned aside  
When mirth and gladness filled the brimming days;  
Who else so fit as he for pleasure's ways?  
Men thought him frozen by a selfish pride;  
But that his voice was music none denied,  
Or that his smile was like the sun's warm rays.  
One day upon the sands he spoke in praise  
Of swimmers who were buffeting the tide;  
'The swelling waves of life they dare to meet.  
I may not plunge where others safely go,—  
Unbidden longings in my pulses beat.'  
O, blind and thoughtless world! you little know  
That ever round this hero's steadfast feet  
Surges and tugs the dreaded undertow."

### **French Campaign Against Alcohol**

The following interesting Official Bulletin was posted a few years ago in various parts of Paris with the object of educating the public and particularly the poorer classes to the moral, physical and economic effects of alcoholism or excessive drinking:

## FRENCH REPUBLIC

Liberty

Equality

Fraternity

General Administration of Relief of the Poor in Paris.

## Alcoholism: Its dangers

*(The following are extracts from the Official Manifesto, appearing under the above heading.)*

Alcoholism is chronic poisoning resulting from the habitual use of alcohol even when this is not taken in amounts sufficient to produce drunkenness. It is an error to state that alcohol is necessary for workmen who are engaged in arduous manual labor, that it gives energy for work or that it renews strength. The artificial excitement which it produces quickly gives place to nervous depression and weakness.

---

The habit of drinking spirits leads quickly to alcoholism, but the so-called hygienic drinks also contain alcohol; the only difference is one of quantity; the man who daily drinks an *immoderate* quantity of wine, cider or beer becomes as surely alcoholic as the one who drinks brandy.

---

The drinks called "Aperitifs" (absinthe, vermouth), and the aromatic liqueurs (such as Creme de Menthe), are the most pernicious because they contain—in addition to alcohol—essences which are themselves also violent poisons.

---

The habit of drinking leads to neglect of family, to forgetfulness of all social duties, to distaste for work, to want, theft and crime. It leads to the hospital—for alcoholism causes a great variety of diseases, many of them most deadly: paralysis, insanity, disorders of the stomach and of the liver, dropsy; it is one of the most frequent causes of consumption.

---

The hygienic faults of parents are visited upon their children.

---

Alcoholism is one of the most frightful scourges, whether it be regarded from the point of view of the health of the individual, of the existence of the family, or of the future of the country.

**Statistical Investigations Into Causes of Alcoholism**

Investigations into the causes which led to alcoholism, conducted at the Bellevue and Allied Hospitals, New York, with 246 patients, gave the following results:

	Per cent.
Sociability,	52.5
Trouble—business or domestic,	13.
Medical Use,	9.3
Occupation,	7.
Taught by elders,	7.
Out of work,	5.
Unknown,	5.
To be considered "sporty,"	1.2
Total,	100.0

**Statistics Showing Ages at Which Alcoholism Begins**

An investigation, with 259 alcoholic patients, to determine the age when they commenced taking alcoholic beverages gave the following interesting results:

	Per cent.
Between the ages of 1 and 12,	6.5
Between the ages of 12 and 16,	23.
Between the ages of 16 and 21,	39.
After 21,	31.5
Total,	100.0

Dr. Brandthwaite's investigations among inebriate English women in reformatories indicated that 42 per cent. had commenced to drink to excess before they were 21 years of age.

Robert R. Batty, Sociologist, has said, "It is during adolescence that the taste for alcohol declares itself. It is a noteworthy fact that in nearly 90 per cent. of confirmed inebriates the addiction to drink begins between 15 and 25 years of age."

Investigations in the Public Schools of Philadelphia showed that out of 18,503 children in 23 schools, 4,438, or nearly one-quarter admitted that they drank alcoholic beverages. To feed alcohol or any drug in any form, except in severe illness, to children is not only indicative of parental ignorance, but it is an outrage committed against one's offspring and society and can be truthfully termed criminal. Dr. Rankine has truly said, "The stern forbidding of the use of both alcohol and tobacco under the age of puberty would shield the nervous centers from two of their most deadly enemies." Dr. Rankine does not carry his advocacy of abstinence far enough. It should cover the period of adolescence and no minor should be given alcohol or any drug except pathologically. Bauderlier and Roepke have said, "Above all, parents and educators must be shown that alcohol in any form or any quantity must be forbidden to children and youths. If they are allowed to take alcohol regularly to strengthen them or for other reasons, a race of candidates for consumption will be produced." No minor needs alcohol, tea, coffee, tobacco or drugstore "doped" drinks and their health during growth and development demands total abstinence from all poisons. There are about thirty million children under fifteen years of age in the United States, and a large percentage of these boys and girls are suffering because of the ignorance and indifference of their parents, teachers, guardians and doctors in regard to food, drink, air, exercise, confined studies, quackery, belief in everything they see in print, including spurious advertising, medical charlatanry and superstition. No child needs alcohol except under certain conditions when suffer-

ing from severe disease and then it should be administered pathologically by a skilled professional physician and not by the parents or a medical mountebank. A belief in the strengthening and supporting qualities of alcohol, for people in health and all who live approximately normal or sane lives, is fast becoming as obsolete as the belief in witchcraft.

### **Effects of Parental Alcoholism on Offspring**

Alcoholism which can be defined as a diseased condition caused by the continued, excessive use of alcoholic liquors and habitual inebriation is not only abuse of the human body but a crime and a gross violation of nature's laws which may result in an impaired, weakened and abnormal constitution being transmitted to an inebriate's offspring. "Alcoholism," said Dr. Lunier, "strikes a man not only in his person but also in his descendants," and Galton has said, "The individual is the trustee of the germ cells." There are too many criminal, imbecile and physically diseased persons and too high a death rate among the offspring of drunkards as compared with the children of sober or normal people to warrant letting such facts pass without comment. Imbault found that 36 per cent. of tuberculous children were the offspring of inebriates. Arrivé investigating 1,506 cases of juvenile meningitis found this malady to be twice as frequent in the children of parents addicted to alcoholism as in those of parents seriously suffering from other wasting and degenerative diseases. In an investigation on the effects of parental alcoholism on the offspring, Sullivan gives some important figures which have been plotted diagrammatically.

To avoid other complications he chose female drunkards in whom no other degenerative features were evident. Guyer reporting these investigations say, "He found that among these the percentages of abortions, still-births and deaths in infants before their third year was 55.8 per cent. as against 23.9 per cent. in sober mothers. In answer to the ob-

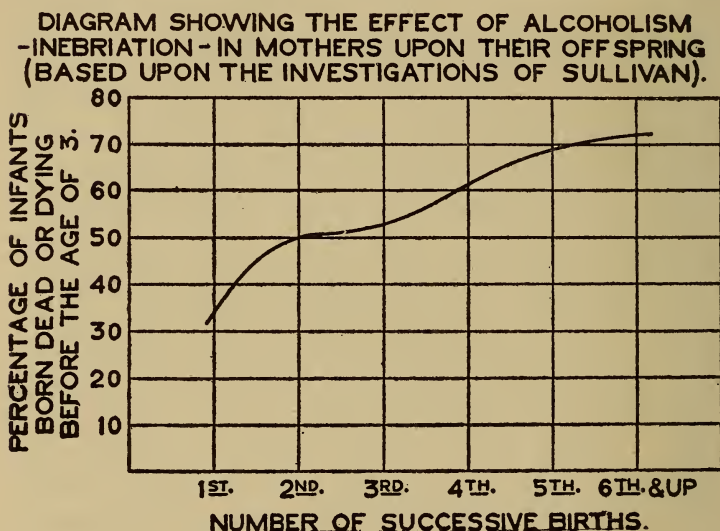


FIG. 34

jection that this high percentage might be due to neglect and not to impairment of the fetus by alcoholism, he points out the fact based on the history of the successive births, that there was a progressive increase in the death rate of offspring in proportion to the length of time the mother had been an inebriate."

Dr. Branthwaite, Inspector under the British Inebriates Act, reports that his investigations show that 1291 women admitted to Inebriate Reforma-

tories had given birth to 4,086 children of which 44 per cent. were dead.

Forel, the noted psychiatrist of Zurich, Switzerland, has said, "The offspring tainted with alcoholic blastophoric suffers various bodily and physical anomalies among which are a predisposition to tuberculosis and epilepsy, idiocy—moral and general—rickets, dwarfism, a predisposition to crime and mental diseases, sexual perversions and many other misfortunes."

Alcoholism in men is deplorable and a disease of blighting depravity, but alcoholism in women, who are highly organized, sensitive, responsive, and nervous creatures and the mothers of the race, results in no uncertain manner in the vitiation, degeneration and suffering of offspring, and feminine inebriation must be considered as a positive expression of moral corruption and wickedness.

That alcoholism in men affects the health of offspring is well known, but it is not evident to the degree that exists with women. It may be, however, that the known and investigated cases of alcoholism in women who are mothers would reveal the fact that the fathers were also inebriates, for alcoholic women would most probably cohabit with men addicted to alcoholism, whereas many a normal and moral woman, free from any depraving vice, has the misfortune to be married to a drunkard. If this assumption is correct, alcoholism in women could be considered in many and possibly in the majority of cases to mean inebriation of both parents, whereas alcoholism in men would probably, in relation to offspring, be considered to more generally refer to the inebriation of the male parent only.

There are many cases of record where women married to sober men have given birth to healthy normal children and when married before or later to inebriates have had the misfortune to bring abnormal and physically or mentally diseased children into the world. Schweighofer and Forel both tell us of a normal healthy woman who had three sound children when married to a normal man. "After the death of this husband she married an inebriate by whom she had three other children. One of these suffered from infantilism, one turned out to be a drunkard and the third became a social degenerate and drunkard. Moreover, the first two contracted tuberculosis, although hitherto the family stock had been free from this malady. Ultimately the woman married again and by this third husband, who was normal, she again had sound children."

Prof. Demme, of Berne, Switzerland, has made comparative observations and investigations upon 10 alcoholic and 10 temperate families, for 12 years living in the same circumstances and following similar trades, and his findings were as follows:

	Alcoholic	Temperate
Total Number of Children,	57	61
Number deformed,	10	2
"    idiotic,	6	0
"    epileptic, choreic,	6	(2 backward)
"    non-viable,	25	3
"    normal,	10	54

Therefore, 17.5 per cent. of the alcoholic and 88.5 per cent. of the temperate progeny were normal.

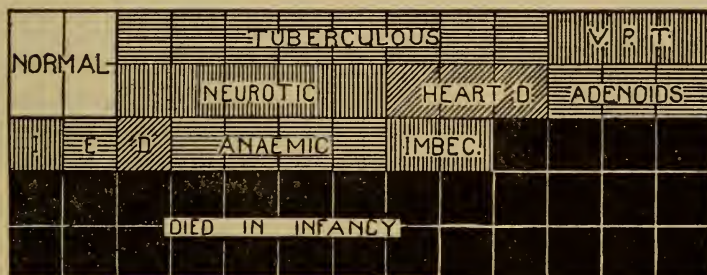
Prof. Demme also analyzed the intemperate families according to ancestral drinking habits and found that the abnormalities increased with the

extent of ancestral drinking, as the following table shows:

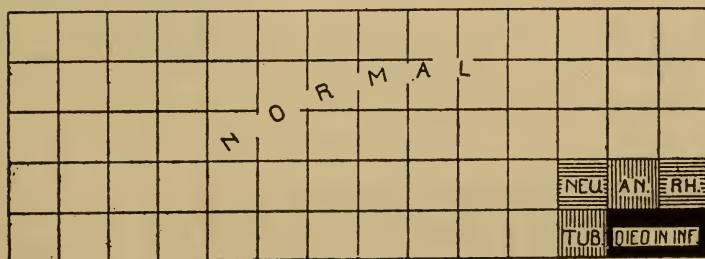
Drinkers	No. of Families	No. of Children	Normal	Died Young	Defective
Father only,	3	20	7	7	6
Father and Grandfather,	6	31	2	15	14
Father and Mother,	1	6	1	3	2

Dr. T. A. MacNicoll, of New York, has obtained statistics in his study of ten other families of drinkers and ten families of abstainers, from which the accompanying comparative charts have been prepared:

### A RECORD OF TWENTY FAMILIES



Sixty-five Children of Ten Families of Regular Drinkers.



Seventy Children of Ten Families of Abstainers.

FIG. 35

Alcoholic Families		Families of Abstainers
65	Number of Children	70
30	Died in Infancy	2
8	Tuberculosis	1
5	Neurotic	1
4	Anaemic	1
3	Very poor teeth	0
3	Heart Disease	0
3	Adenoids	0
3	Imbecile, Insane	0
1	Epileptic	0
1	Diabetes	0
0	Rheumatic	1
4	Normal	64
6.15	Percentage normal	91.43

Of the rating in school 8 of the children of the alcoholics' and 66 of the abstainers' offspring were fair and better. Dr. MacNicoll states that his investigations indicate that the degenerative factor becomes more potent with each transmission and renders posterity more and more susceptible to disease. An illustration may be noted in the children of ten families of drinking parents traced through three generations:

Generation	No. of Children	Percentage suffering from organic and functional diseases
First,	47	50
Second,	90	62
Third,	82	95

MacNicoll further says that as a result of his study during 20 years, he is convinced that for every child of total abstainers that dies under 2 years of age, five children of excessive drinking parents die; that one child out of every five born to parents

addicted to alcoholism will become ultimately insane, and one child out of every three will suffer from epilepsy and hysteria.

Doctor Jacquet, of the Hospital Saint-Antoine, Paris, during 1912-12 conducted a thorough investigation covering the infant mortality record of 396 families, having a total of 879 children. He divided the patients into three classes, with results as follows:

	No. of Patients	No. of Children	No. of Deaths	Percentage of Mortality
Moderate Alcoholism; those who drink 1 litre of wine, alcohol or rarely aperients	141	305	83	18.78
Decided Alcoholism, those who drink habitually from 1.5 to 2 litres of wine, alcohol or absinthe rather frequently .....	108	248	115	26.01
Very Decided Alcoholism; those who drink habitually 2 litres of wine or more, aperients, alcohol, occasional repeated absinthe..	147	326	244	55.47
Total .....	396	879	442	50.28

Prof. G. von Bunge, of Basel University, Switzerland, made an investigation of the families of

149 occasional drinkers,  
169 habitual moderate drinkers,  
67 habitual immoderate drinkers,  
60 confirmed drunkards,

to determine the relation between alcoholism and tuberculosis on the progeny of hard and moderate drinkers. In this investigation only those results were recorded of families in which both parents were free from any chronic disease and where the

history of the father's drinking habits was fully known. The results he obtained are of interest:

	Per cent.	
Children of occasional drinkers,	8.7	Tubercular
Children of habitual moderate drinkers,	10.7	"
Children of habitual immoderate drinkers,	16.4	"
Children of confirmed drunkards,	21.7	"

The percentage of defective children in these families were 2.3 per cent. for the occasional drinkers, 4.6 per cent. for the regular moderate drinkers, 9 per cent. for the regular heavy drinkers and 19 per cent. for the drunkards.

The Phipps Institute (Pennsylvania) reports in 1907 that 37 per cent. of the tuberculosis patients who were of alcoholic parentage improved and 13.5 per cent. died; but of patients of non-alcoholic parentage 47 per cent. improved and only 9.4 per cent. died.

Prof. Laitinen, of the University of Helsingfors, has reported a comparison of children of fifty temperate or abstaining and fifty-nine drinking families in one village in Finland. In the temperate families the weakly children were found to constitute 1.3 per cent.; in the drinking families they were 8.2 per cent. Of the children in the temperate families 18.5 per cent. died in infancy; in the drinking families 24.8 per cent. died. In the abstaining families 0.94 per cent. of all births were miscarriages; in the drinking families there were 6.21 per cent., or nearly seven times as many.

Prof. Laitinen carried his studies of the mortality of children into a large number of families with the following results:

No. of Families considered, 5,736

No. of Children in these families, 19,519

	Percentage of Children Dead	Miscarriages Percentage of Births
Abstaining parents,	13	1.07
Moderate drinking parents,	23	5.26
Immoderate drinking parents,	32	7.11

Dr. Scharlieb states that Alcohol is present in the milk of the heavy-drinking mother; "the child receives Alcohol as part of his diet with the worst effect upon his organs, for Alcohol has a greater effect upon cells in proportion to their immaturity."

In a study of the mental efficiency of ordinary children undertaken in 1901 for the New York Academy of Medicine, by Doctor MacNicoll, 55,000 school children were examined. Of these 58 per cent. were below the required standard of intelligence, 16 per cent. being deficient, 25 per cent. very deficient and 17 per cent. dullards.

The habits of the parents with regard to alcohol was reported in 20,147 cases, with the result that 53 per cent. of the children of alcoholic parents and 10 per cent. of the children of temperate parents were found to be dullards.

The family histories of 3,711 children were traced through three generations, with the following results:

- (1) Of those free from hereditary alcoholic taint,
  - 96 per cent. were proficient,
  - 4 " " were dullards,
  - 18 " " suffered from some neurosis or organic disease.
- (2) Of those with hereditary alcoholic taint,
  - 23 per cent. were proficient,
  - 77 " " were dullards,
  - 76 " " suffered from some neurosis or organic disease.

Dr. Potts, in his official report on the school children of Birmingham, England, traced backward the relation of children to parents. In the case of 250 mentally defective children he found 41.6 per cent. had one or both parents alcoholic. For comparison, 100 normal children from similar homes in the same district were studied and only 17 per cent. came from alcoholic parentage.

The report of the Committee of Fifty, on the Economic Aspects of the Liquor Problem indicates that 45.83 per cent. of 5,184 destitute and neglected children studied in eight states owed their condition to an alcoholic environment. The Chicago Juvenile Protective Association, in the first half of 1910 dealt with 1,379 cases of adult delinquency toward children and found that 1,034 (75 per cent.) had alcoholism of the parents as the chief cause. Excessive alcoholism robs a child of its right to be well-born, properly nurtured and cared for, and well trained.

All the children of alcoholic parents are not defective, physically or mentally, but that an unusual majority are abnormal and that the tendency is toward degeneration of offspring is undoubted in the light of unbiased scientific investigation. Intebriation and habitual drunkenness should be shunned and avoided as the plague by all fathers and mothers, for alcoholism reacts upon offspring, and in the language of the old law of the Jews "The sins of the fathers (and mothers) are visited upon the children unto the third and fourth generations."

**Alcohol Given to Children and Its Results**

In many of the countries of Europe, parents give their children wine or beer, believing that it is a beneficial drink. In homes transplanted to America, the custom has continued. In a survey made by the Cincinnati Tuberculosis Society in 1912 "in four districts it was found that in the Hungarian families 42 per cent. of the children drank alcohol; in the Italian families 49 per cent.; in the Irish families 48 per cent." Doczi reports that the Hungarian Official Alcohol Commission found that more than a third of the alcohol-using school children were careless and idle, and 20 per cent. were unduly nervous. Hecker, in the Munchen Public Schools, found that "the slowness of perception increased and diligence and progress decreased with pupils in proportion to the extent of their drinking habits."

Emmanuel Bayr, School Director of Vienna, has reported a comparison between the abstaining and drinking school children in Vienna, his investigations covering the records of 588 pupils in 14 classes. Of this number 134 were abstainers, 164 drank alcohol occasionally, 219 took alcohol once each day, 71 twice per day and 3 three times daily. The record of the scholarship of these children is as follows:

	High Marks	Fair Marks	Low Marks
	Per cent.	Per cent.	Per cent.
Abstainers,	42	49	9
Occasional Drinkers,	34	57	9
Once per day    "	29	58	14
Twice per day   "	25	58	18

The Viennese children who drank alcohol took it in the form of beer, wine or rum in tea. Not one

of the three children who took alcohol three times daily showed good marks in school.

Schiavi has made a somewhat similar study of the school children in Brescia, Italy. Records were taken of 3,999 pupils in the Public Schools, with the following results:

	SCHOLARSHIP			
	Percentage	High	Fair	Low
	of total Children	Marks Per cent.	Marks Per cent.	Marks Per cent.
Abstainers,	11.5	42.8	53.4	3.8
Occasional Drinkers,	38.0	30.8	42.	27.2
Daily Drinkers,	50.5	29.8	39.8	30.4

### Alcoholic Experiments on Animals

Exhaustive experiments conducted with animals clearly demonstrate the vicious effect of alcoholism upon progeny. These tests show that with animals as in man, alcoholics are more prolific than normal beings. Laitinen found with alcoholized rabbits and guinea pigs, that more offspring were born dead and the living were stunted as compared with the young of normal animals. Ceni found that only 43 per cent. of the eggs from alcoholized fowls developed normally as against 77 per cent. of normal development in similar fowls naturally fed. Hodge's tests with dogs showed only 17.4 per cent. of healthy normal pups from alcoholized parents and 90.2 per cent. of healthy offspring from similar dogs naturally fed. Stockard's experiments have demonstrated that the offspring of mammals may be injured and detrimentally modified in their development by treating either or both parents repeatedly with alcohol. The guinea pigs used in the experiments were all first tested by normal matings and found to yield normal offspring. The alcohol was

given to them by inhalation. It was found to be readily taken into the animal's blood and to produce intoxication. While guinea pigs, alcoholized in this way as often as six times a week for two and a half years, would apparently maintain their own bodily vigor and health, the deleterious effects on their progeny were marked. The defects were general rather than specific, although the central nervous system and special sense organs were apparently affected most. Out of 119 total young produced by alcoholic animals, only 52 or 43.7 per cent. survived, whereas, out of 64 young produced from normal parents, 56 or 87½ per cent. survived.

The following table has been prepared to give a summary of the most important results obtained from Stockard's tests on the progeny of guinea pigs treated with alcohol. It will be interesting to note the effect of alcohol on the second generation:

Condition of Animals	Total Offspring	Born Dead	Dying Soon After Birth	Total Dead	Total Surviving	Percentage of Deaths to Total Number of Births
1 Male—Alcoholic						
Female—Normal	69	15	21	36	33	52.1
2 Male—Normal						
Female—Alcoholic	28	9	9	18	10	64.3
3 Male—Alcoholic						
Female—Alcoholic	22	6	7	13	9	59.1
Summary of Alcoholic matings	119	30	37	67	52	56.3
4 Male—Normal						
Female—Normal	64	4	4	8	56	12.5
5 Male—Second generation (alcoholic parents)						
Female—Normal	4	0	0	0	4	0
6 Male—Second generation (alcoholic parents)						
Female—Alcoholic	7	5	0	5	2	71.4
7 Male—Second generation (alcoholic parents)	19	0	6	6	13	31.6
Female—Second generation (alcoholic parents)						

The perfect record of second generation males mated with normal females is due to the relatively small number of investigations made; but Stockard's conclusions are that the only hope for such an alcoholized line of individuals is that it can be crossed by normal stock, in which case the vigor of the normal germ cell in the combination may counteract, or at any rate reduce the extent of injury in the body cells of the resulting animal. Prof. Laitinen has made some interesting "long period" tests, using extremely small quantities of alcohol daily for eight months with the water fed to rabbits and guinea pigs. He reports that 51 per cent. of the offspring of the mildly alcoholized animals survived and 62 per cent. of the offspring of similar "control" animals fed with water lived. The results of his investigations in regard to weight and weight-gaining power of the progeny is given as follows:

	RABBITS		GUINEA PIGS	
	Average weight of newly-born Grams	Average daily increase of weight Grams	Average weight of newly-born Grams	Average daily increase of weight Grams
Water and alcohol fed to parents,	79.0	7.13	73.74	4.3
Water fed to parents,	87.9	9.46	77.3	5.2

These tests, he says, prove conclusively the injurious effect of even the smallest quantities of alcohol fed continuously. The tests were made on the basis of .6 oz. of alcohol per day for a man of 150 lbs. weight.

Alcohol has been found to affect the brain centres of the lower animals. Prof. Hodge, referring to his exhaustive experiments says: "The least thing

out of the ordinary, caused practically all the alcoholic dogs to exhibit fear where the others evinced only curiosity or interest," and again referring to his tests on cats he says, "Playfulness, purring, cleanliness and care of coat, interest in mice, fear of dogs, which normally developed before the experiments began, all disappeared so suddenly (when alcohol was administered) that it could hardly be explained otherwise than as a direct influence of the alcohol upon the higher centers of the brain."

Prof. Hodge's retriever tests on dogs are interesting. He took four puppies of the same age, size and physical powers, and in the University Gymnasium where the dogs had been trained to retrieve a ball thrown about 100 feet, he subjected two of the four puppies to the influence of small doses of alcohol and found that the average results for 14 successive days showed that the normal dogs retrieved 66 per cent. of the balls thrown and the alcoholic dogs only 34 per cent. Moreover, the normal dogs, he states, showed greater alertness, strength and energy.

Dr. Magnan, of Paris, describing a dog placed under the influence of alcohol, says that it did not respond to caresses but snapped at kindly attempts to pet it. At night when all was still it would express fear, suffer from insomnia and whine plaintively.

In view of the strong circumstantial evidence present both as regards man himself and the experiments made on animals, there can be but little doubt that excessive alcoholism, that is habitual and persistent inebriation, has a pronounced tendency to produce defective offspring.

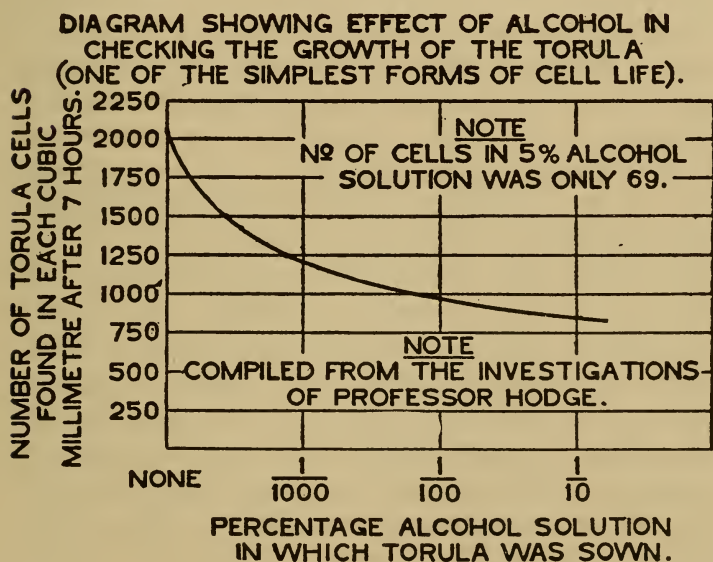
**Alcoholism at Times the Result of Defective Stock**

We should not lose sight of the fact that an antecedent degeneracy or neural instability undoubtedly plays an important part in many cases in the original production of drunkards, and when such weakness occurs, it, as well as the direct effects of alcoholic poisoning, must be reckoned with in the effects on progeny. Studies carried on by Pearson, Elderton and Barrington in London have led these investigators to believe that extreme alcoholic inebriation may be a result of inherited defective stock and not a prime cause of degeneracy. Branthwaite has found as a result of his investigations that 63 per cent. of the inebriates that came under his attention were mentally defective. Michael F. Guyer says, "It is coming to be realized more and more that pronounced alcoholism is due in a large percentage of cases, perhaps over half, to a defective nervous make-up. When children show a hereditary inclination toward drink, unquestionably one of the strongest factors is the inheritance of the same disposition, the same nervous constitution and its accompanying lack of self-control which led the parent to drink, rather than the inheritance of the effects of drink on the parents. In some cases a parent may not become a drunkard until after the children, who also become drunkards, are born. That a tendency to drink immoderately is frequently due to a strain of feeble-mindedness and epilepsy becomes more evident every day."

**Influence of Alcohol on Cell Life**

The bodies of all animals are built up of very small forms of matter called cells. Some microscopic animals have unicellular organisms where all

fundamental functions and processes, such as nutrition, growth, reproduction and excretion take place within this living unity, but by far the greater number of animals and plants are a social mechanism where the organism is not an individual cell, but is built up of thousands or millions of cells with the different required functions distributed among them. This is the case with our own bodies which are built up of many millions of cells arranged in organs, each with its own duty to perform. It is



interesting to study the effect of alcohol, not only upon animals but upon cell life, for as Prof. Hodge has said, "By studying the influence of alcohol upon these functions in simpler organisms, evidence may be gained by which more clearly to interpret the human experiment."

One of the simplest forms of cell life is the *Torula*, which consists of a single cell possessing a power of rapid multiplication by subdivision. The growth of this cell has been investigated by Prof. Hodge, both in a simple nutrient solution and in the same fluid to which a small quantity of alcohol had been added. He found that the rapidity of growth of the *Torula* was lessened and inhibited when alcohol was present, and the general results of his experiments have been plotted in the diagram on page 479.

It is interesting to note that actual stoppage of growth occurred when the proportion of alcohol reached 14 per cent.; and when the nutrient solution contained 5 per cent. of alcohol, the number of *Torula* cells per cubic millimeter after seven hours, was only 69, or only 3.3 per cent. of the number produced in a normal non-alcoholic solution.

Dr. Ridge has proved that cress seeds are killed by a one per cent. alcoholic solution, and smaller quantities of alcohol retarded the normal growth. Small quantities of alcohol were found to have a pronounced deleterious effect upon the green coloring matter of plants (as does also lack of light and sunshine). Richardson found that an extremely mild alcoholic solution proved fatal to fresh water medusæ (jelly fish), water fleas, etc. Prof. Rauber, using relatively stronger alcoholic solutions, generally 10 per cent., found that alcohol acts as a definite protoplasmic poison upon all the forms of cell-life upon which he experimented; that plants become shrivelled and pale; that animals become intoxicated and poisoned and that those that live in water soon die. "Crayfish placed in a 2 per cent. solution of alcohol succumb within a single day;

perch placed in a 2 to 4 per cent. solution become rapidly intoxicated, fall to the bottom of the vessel and die."

Stockard found that a 5 per cent. alcoholic solution caused defects in development of from 90 to 98 per cent. of fish eggs. His tests on fish and guinea pigs proved that alcohol attacked first, in accordance with physiological laws, the highest and most specialized nerve tissues and centers, such as eyes, ears, and, in severe cases, the brain itself. Frere made comparative tests with the hatching of chickens in incubators, with and without the presence of alcoholic vapors, and found a large percentage of abnormalities in the chickens hatched under the influence of alcohol.

#### **Alcohol in Relation to Climatic Conditions**

The notion, once very prevalent and still often expressed and firmly held, that alcohol in some form or other is necessary for those living in tropical climates, has been and continues to be a most mischievous delusion. Sir J. R. Martin, Surgeon of Calcutta, India, has said, "We hear much about the supposed preventive influence of spirits and tobacco against night exposure, malaria and contagion, but no medical observer in any of our numerous colonies has ever seen reason to believe in any such delusive doctrine, nor is there in reality the smallest foundation for it." Dr. Fergusson, Inspector-General of the British Military Hospital Service, said many years ago, "To administer spirits under a burning sun as an article of food, or to allow a man access to them as preparatory to duties of exertion and fatigue or even with a view of supporting him under them, is about as judicious as it

would be to give him a blow on the head. The one would not more certainly disqualify him for every purpose of service than the other." The use of alcohol in the Tropics is contra-indicated by every known fact of hygiene and scientific observation and all the authorities now agree that the less any one, who may be called upon to visit or live in tropical countries, takes in the way of alcohol, the better it will be for his health, physical comfort and adaptability to extreme climatic conditions. Dr. Bryden in the "Vital Statistics of Bengal" has shown that nothing is more inimical to acclimatisation in India than the habitual and steady use of alcohol. Many other authorities have testified concerning life in moist Tropical climates, that a vast amount of mortality and disease has in the past been attributed to climate, which was in reality the result of defective hygiene and errors in eating and drinking. Horsley and Sturge, commenting on the building of the Panama Canal through a fatal spot on the globe for workers, have written, "There are two reasons for this remarkable result; firstly, destruction of the mosquito and thereby the removal of liability to yellow fever and malaria, and secondly, abolition of alcohol from the district covering a broad strip, five miles wide, on each side of the Canal."

Drs. Castellain and Chalmers, in their recent Manual of Tropic Medicine, say that alcohol should never be taken in the Tropics till the sun goes down, for it unfits the individual for work and is the most important, predisposing cause of sunstroke. They state that alcohol causes heat exhaustion and these facts account for the difference in mortality of expeditions in which soldiers are allowed to drink it

and those in which they are not. It is well known that sunstroke attacks those addicted to alcohol much quicker and more disastrously than temperate people. Dr. Phillips, of Washington, in "Meteorological Conditions of Sunstroke" gives some interesting results of his investigations, covering 465 cases and 70 fatalities, from which the following table has been prepared:

Known Personal Habits,	Sunstroke	Fatal
	Cases Percentage	Sunstroke Cases Percentage
Excessive indulgence in Alcohol,	30	60
Moderate indulgence in Alcohol,	50	30
Very temperate indulgence in Alcohol, or abstainers,	20	10

The Swedish investigations of Mernetsch, to determine the effect of alcohol upon the soldier during manœuvres, clearly showed that predisposition to sunstroke and "heatstroke," was reported only among "alcoholic" companies.

Excessive external heat produces physiological effects on the body very similar to those caused by alcohol, viz.: dilation of the blood vessels, flushing of the skin surface, depression of the heart's action and of the nervous system. Horsley and Sturge have aptly said that the fatal error in the use of alcohol is chiefly due to the non-appreciation of the fact that it acts upon the body, with certain limitations, like a hot sun and consequently one dangerous agency simply aggravates the evil effects of the other. Rogers tells us that the many cases of liver abscess in India are primarily due to alcoholism. Eighty years ago liver abscesses were rarely found in the natives, but it was frequent among the

Europeans who had brought to India their alcohol-drinking and heavy-eating habits. We are now told that liver disease is very common among the natives and that 70 per cent. of the cases are traceable to alcoholism. It is interesting to note that such disease is rare among the females who take but little alcohol and among the Mohammedans whose religion forbids the use of it. "It is significant that the recent development of liver abscess among the Hindus coincides with the spread of the use of alcohol among them."

The British Government during the past three decades has done effective work to reduce the use of alcohol among the soldiers in India and this in the interest of efficiency, health, morals, endurance and reliability. The following diagram shows the number of admissions to the hospitals for alcoholism have steadily declined:

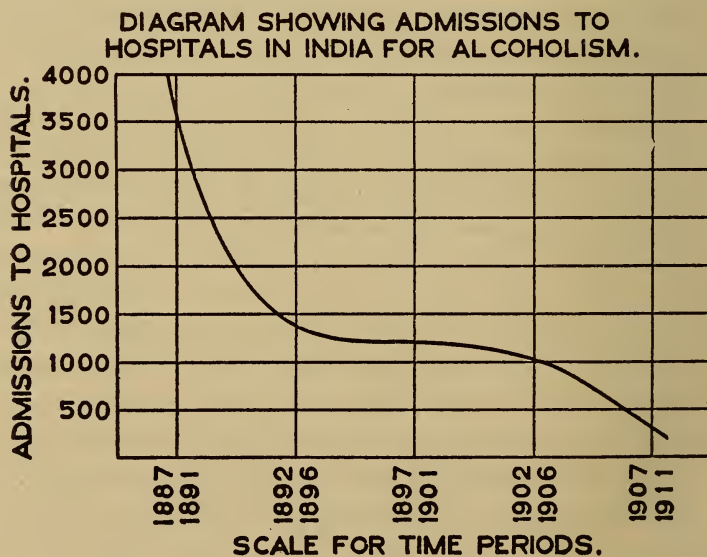


FIG. 37

The experience of our armies in the Indian, Mexican and Civil Wars indicates that spirit rations are harmful in cases of exposure, dysentery and diarrhoea. Duncan sums up the experience of the British Army in its colonies when he says, "Cholera ever attacks the intemperate first and cholera prefers alcohol drinkers." Alcohol, taken habitually plays an important role in lowering the resistance of the body and especially the defensive power of the blood against noxious parasites. If taken habitually and immoderately, the evils are naturally greatly intensified. The Tropics afford a setting where malaria, backwater fever, yellow fever and diseases caused by the introduction of potent poisons into the body by the stings of infected insects, are prevalent. To combat such diseases the body tone must be high, therefore, any agent which tends to reduce the power of resistance should be avoided. The French authority, Maradro, has truly said, "It has been demonstrated that intermittent fevers (malaria), especially in their pernicious forms are both more frequent and more rapidly fatal among those who take alcohol than among those who avoid all alcoholic drinks."

In hot climates, alcohol used habitually even moderately, or used occasionally to excess, is deleterious to health. It lowers the tone of the system, weakens the resistance of the blood to disease, draws blood from the internal organs and flushes the skin with blood. The similar use of alcohol in very cold climates, such as is experienced in the Frigid Zone, or during the severe winter in the Temperate Zone, is likewise fraught with much danger and has been proven conclusively to be opposed to health and longevity. One of the main functions of the human

skin is the regulation of the body temperature which must be controlled with great nicety and this is accomplished by means of the nervous system, which causes and regulates variations in the size of the blood vessels of the skin, thus permitting much or little warm blood to flow to the skin and cause bodily heat to escape to the atmosphere. Normal blood vessels of the skin normally controlled by a healthy and natural mode of life readily respond to the requirements of the body. "On a warm day these vessels dilate and permit a considerable amount of blood to come to the surface of the body and thus increase the loss of heat, for the air surrounding us is nearly always cooler than the body. It follows that we give off heat to the atmosphere and that we do so more rapidly if our skins are flushed with blood. Consequently whenever our skin-vessels are dilated and full, the body is cooling and our internal temperature is being lowered." In hot climates alcohol tends to impoverish the bodily organs and inhibit those properties of the blood which destroy noxious bacteria and counteract disease, it causes a rush of blood to the head and to the skin; but the air breathed, the atmosphere surrounding the body and the blood temperatures may all be approximately the same and heat exhaustion may result from lessened vitality plus faulty circulation. In cold climates, however, the effect of alcohol on the blood vessels of the skin is most serious for here we are confronted with an air intake to the lungs of zero or even 50° F. below zero and a skin radiation loss due to blood at about 100° F. or say 150° F. above the surrounding atmosphere passing off into the enveloping extremely cold air. Alcohol under these conditions causes an apparent warming of the body

due to the rush of blood to the skin, the heating of the surface of the body with possibly some perspiration; but a quick and pronounced radiation loss is experienced, the bodily organs are robbed of blood and the body temperature is lowered and rendered less efficient in its resistance to outside cold and this in addition to the deleterious effect of alcohol upon the disease-destroying properties of the blood. Dr. John Rae, the Arctic explorer, has said, "The greater the cold, the more injurious is the use of alcohol," and Sir J. Ross in his "Voyage to the Arctic Regions" says, "The most irresistible proof of the value of abstinence was when we abandoned our ship and were obliged to leave behind us all our wine and spirits. It was remarkable to observe how much stronger and more able the men were to do their work when they had nothing but water to drink." Burton in "The Action of Medicines" tells us of some Northern Canadians who, when exposed to a very severe winter in the woods, destroyed a cask of whiskey, "for if it was there, they felt quite sure that they would drink it and if they drank it they were likely to die." He also tells of a party of engineers surveying in the Sierra Nevadas—"They camped at a great height, where the air was very cold and they were miserable. Some of them drank a little whiskey and felt less uncomfortable; some of them drank a lot of whiskey and went to bed feeling very jolly and comfortable." During the night the cold became intense and the weather severe. "In the morning the men who had not taken any whiskey got up all right; those who had taken a little whiskey got up feeling very unhappy; the men who had taken a great deal of whiskey did not get up at all—they were simply frozen to death for they had

warmed the surface of their bodies temporarily at the expense of their internal organs."

When Sir Benjamin Richardson in 1866 lectured before the British Association that Alcohol actually lowered the bodily temperature, he encountered so much prejudice of ignorance that his paper was returned to him for correction before it could be incorporated into the Official Transactions of the Society. Prof. Schäfer has stated that "Alcohol taken in ordinary quantities as a beverage causes a slight depression, generally less than half a degree in the temperature of healthy men; on the other hand, poisonous doses may cause a fall of  $5^{\circ}$  or  $6^{\circ}$ —in fact many of the lowest temperatures recorded have been observed in drunken persons exposed to the cold." Many authorities have stated that a large percentage of the so-called "deaths from exposure" in winter weather of civilized countries in the Temperate Zone could be more truthfully expressed as "deaths from alcoholism."

Dr. Nansen in "The First-Crossing of Greenland" writes, "My experience leads me to take a decided stand against the use of stimulants and narcotics of all kinds."

The greatest drink that one can take to warm and brace up the body when subjected to severe cold atmospheric conditions is the food drink—hot milk. Drugged drinks such as tea and coffee are injurious and the only food value which they contain is in the sugar, milk or cream placed therein to make them palatable. Hot tea is also apt to cause profuse perspiration but hot milk while it opens the pores of the skin feeds the body, as it is one of nature's prime foods; it will give the sensation of warmth and comfort and in addition feed the blood and save the

organs and blood from the deleterious effect of drugs. If hot milk is not procurable, pure hot water is preferable to drugged hot waters, and if perspiration is desired a hot lemonade is preferable to hot tea.

### **Alcoholic "Tolerance" Varies With Individuals**

The effect of alcohol on an individual is influenced very materially by his temperament and constitution. Individuals vary in their "tolerance" of alcohol, and it is an interesting fact that persons of a mental or nervous temperament are more deleteriously affected by alcohol, caffeine and generally similar drugs than are persons of a physical or phlegmatic temperament. The more highly developed and finely tempered a man's nervous system, the more susceptible is his body to the ravages of alcohol; this does not necessarily mean the quicker he will become inebriated, for his stomach may vigorously protest and decline to receive sufficient alcohol to cause, when assimilated, the condition known as intoxication. The nervous, mental type of man is an easy prey to the physical evils arising from the use of alcohol. The motive and vital types have a greater degree of tolerance and more constitutional resistance, particularly if the temperament is physical. Men retain and "stand their liquor well" according to their mental and nervous development. The man with the low head, heavy jowls and thick brutish neck—the physical type—will generally stand the effects of much alcohol without pronounced constitutional impairment, but the man with the high head, triangular face, thin neck and relatively light weight—the mental type—is soon harmfully affected and has a low degree of tolerance.

Those qualities in man which make for progress and the advance in knowledge and civilization, soon succumb to the ravages of alcohol, and it is a regrettable fact that highly organized creatures often living a life of mental activity beyond their bodily strength, crave the influence of stimulants and narcotics, the habitual or excessive use of which—whether it be alcohol, caffeine or cocaine—will lead to a broken constitution and much misery.

There are men so constituted that they can withstand alcohol very well in moderate doses taken habitually or intermittently. Many men who have been steady drinkers have lived to a ripe old age, but as the world moves onward and the pace and stress of life increase, men are becoming more mental and nervous; the survivors in the race, as well as the leaders of the world to-day are the men of brain rather than of brawn, of top head rather than cerebellum and bullish neck; such men, because of their mental development and highly tensioned nervous system, cannot partake of alcohol or drugs habitually or to excess, without having their efficiency marred, their working power lessened, their lives shortened and their constitutions impaired.

#### **Alcohol and the Soldier**

At the dedication of the Imperial Naval Academy at Murvik in 1910, Kaiser Wilhelm, of Germany, said, "The next war, the next naval encounter, will require of you sound nerves. These are undermined by alcohol, endangered from youth up by its use. . . . The nation which drinks the least alcohol will be the winner."

The late Field-Marshal Von Moltke expressed

his general views on this same subject when he said, "Beer is a far more dangerous enemy to Germany than all the armies of France."

Every German recruit of the Imperial Navy or Army has on his entrance into the service for several years been provided with a pamphlet showing the connection between alcohol and the military strength of the nation. A recent order from the War Department to the army in the field says:

"At first alcohol supplies a certain liveliness, but with the consumption of larger quantities it causes somnolence. Experience teaches that abstinent soldiers can best resist the fatigues of war. Besides, the use of alcohol leads to excesses and dissoluteness. Alcohol, therefore, is to be used with the greatest care, and is to be absolutely avoided on the march. For giving warmth it is not to be recommended. The warmth which it conveys is entirely deceptive. All in authority are requested to pay strict attention to the necessity of limiting its use."

The deplorable European War has caused several of the belligerent nations to pass regulatory or prohibitory measures in regard to alcohol. Simultaneously with the order for the general mobilization of the Russian troops in the latter days of July, 1914, went the order to close immediately all vodka, wine and beer shops in the Empire, an exception being made in the case of first-class restaurants. This order was promulgated by Grand Duke Nicholas, Commander-in-Chief of the Russian forces, and was purely a mobilization measure to prevent disturbances similar to those which accompanied the mobilization for the Japanese war in 1904. The order was effective until complete mobilization should be accomplished. W. E. Johnson says, "The results of this order were surprising.

Russia accomplished her mobilization in less than one-half the time it was expected to take. The rapid mobilization of the Russian forces, made possible by the closing of all drinking places, was the first disappointment to German calculations." The Tsar, on August 22, 1914, in response to persistent demands, ordered that the existing prohibition of the sale of vodka and spirits be continued until the close of the war, and other rulings have left the sale of wine and beer to the decision of the local authorities, under a sort of local option system. Vodka has been found in Russia to be inimical to efficiency, hence the Imperial "Ukase" which has practically established prohibition.

Kitchener's first message to the British Troops engaged in the present war, cautioned them against the evils of alcohol, and later stringent regulatory measures relative to alcoholic drinks were adopted in Britain. Earl Roberts has said, "Give me a temperate army and I will lead it anywhere—thirteen thousand abstainers are equal to fifteen thousand drinkers." Lord Wolsely said, "Drink kills more than our newest weapons of warfare," and General Ian Hamilton has asserted that "whiskey paralyzes the power and the life of the finest and bravest troops in the world." Sir John French, at the front, remarked, "Abstinence and self-control makes a man more serviceable." Lloyd George, battling for efficiency and the desired output from the British Munition Factories, in February, 1915, said, "Drink is doing more damage in the war than all the German submarines put together," and speaking as Chancellor of the Exchequer to a deputation of the Shipbuilding Employers Federation, he said:

"We are fighting Germany, Austria and drink, and, so far as I can see, the greatest of these three deadly foes is drink. I have a growing conviction, based on accumulating evidence, that nothing but root-and-branch methods would be of the slightest avail in dealing with the evil. I believe it is the general feeling that, if we are to settle with German militarism, we must first of all settle with liquor."

Lieut. Sir Reginald Hart has said, "As an officer I support temperance because I know that officers and men who avoid drink are physically and mentally more efficient, their nerves are stronger, they march better, there is far less sickness and crime, their power of resistance is strengthened." It is interesting to note that Lord Kitchener in the Soudan Campaign, and General Sir Francis Grenfell in service in Egypt, allowed their men no spirits whatever. In the war between Great Britain and the Transvaal, the use of spirits was prohibited among the Boers, and it was reported that the wonderful power of endurance of the Boer army was in great part due to their abstinence from strong, spirituous drinks. Sir Frederick Treves, reporting on the movement of the British Relief Column that reached Ladysmith after a most trying experience and forced marches in hot weather said, "The first who dropped out were not the tall men, or the short men, or the big men, or the little men—they were the drinkers and they dropped out as clearly as if they had been labelled." Admiral Sir J. R. Jellicoe of the British Fleet has recently added his testimony in the interest of temperance by saying, "As regards straight shooting, it is everyone's experience that spirituous abstinence is necessary for efficiency. By careful and long tests the shooting efficiency of the men was proved to be 30 per cent. worse after the rum ration than before it."

Coincident with the mobilization of the British troops, at the outbreak of the European war in the summer of 1914, the leading English military authorities issued statements and interviews against the use of alcoholic liquors, and the following posters were published by the government:

**EFFECTS OF ALCOHOL ON NAVAL AND MILITARY  
WORK**

**TO ALL MEN SERVING THE EMPIRE.**

**It has been proved by the most careful  
SCIENTIFIC EXPERIMENTS,  
and completely confirmed by actual experience  
In ATHLETICS and WAR**

**as attested by**

**FIELD-MARSHAL LORD ROBERTS, V.C., K.G., K.P.,**

**FIELD-MARSHAL LORD WOLSELEY, K.P., G.C.B.,**

**and many other Army Leaders, that**

**Alcohol or Drink**

- (1) SLOWS the Power to see Signals.**
- (2) CONFUSES Prompt Judgment.**
- (3) SPOILS Accurate Shooting.**
- (4) HASTENS Fatigue.**
- (5) LESSENS Resistance to Disease and Exposure.**
- (6) INCREASES Shock from Wounds.**

**We therefore most strongly urge you for your own  
Health and Efficiency that at least as long as the War  
lasts you should become**

**Total Abstainers.**

**(Signed)**

**THOMAS BARLOW, M.D., F.R.S., K.C.V.O.,**

Pres. Coll. Phys., Physician to H. M. the King.

**FREDERICK TREVES, F.R.C.S., G.C.V.O.,**

Hon. Col. R.A.M.C., T.F., Sergeant Surgeon to H.M. the King.

**G. J. H. EVATT, M.D., C.B., Surgeon-General R.A.M.C**

**VICTOR HORSLEY, F.R.C.S., F.R.S., Captain R.A.M.C., T.F.**

**G. SIMS WOODHEAD, M.D., F.R.S., Lieut.-Col. R.A.M.C., T.F.**

**(BRITISH WAR POSTER.)**

The following is a reproduction of a typical British War Poster, urging the people in the interest of patriotism, power, economy and, therefore, national strength and endurance, to abstain from alcoholic beverages for the duration of the war:

# **THE WAR**

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## **A PATRIOTIC APPEAL**

IS MADE TO

### **THE NATION**

To Abstain from Alcoholic Drink During the War

ON THE GROUND THAT:

1. **THE GRAIN** destroyed for their production is required for **FOOD**.
2. **THE MONEY** spent upon **DRINK** will purchase many times its value in **FOOD**.
3. **PHYSICAL POWER** depends upon **FOOD**, and must not be destroyed by **ALCOHOL**.
4. **ALCOHOL** lowers vitality and diminishes power to resist **DISEASE**.

### **PATRIOTISM**

Demands a whole-hearted response from all classes  
to this appeal.

(BRITISH WAR POSTER.)

Item I of the above poster recalls the words of Dr. C. J. Saleeby: "The manufacture of whisky is the decomposition of food into poison, when food supply may decide the fate of freedom."

Early in the present war, King George and other prominent Englishmen voluntarily agreed to abstain from the use of alcoholic beverages during the continuance of hostilities. The Royal Bulletin read as follows:

"By the *King's command* no wines, spirits or beer will be consumed in any of his Majesty's houses after to-day, April 6, 1915."

The prime thought behind this much heralded act was to set an example to the public and particularly to the artisan and laborer. Lord Kitchener and certain other national leaders promptly followed the Royal announcement by stating that alcohol would be excluded from their households. In further response to the King's action, evangelical churches at once organized wide-spread pledge-signing, and as a result of this movement it is estimated by religious bodies, prohibitionists and temperance advocates, that about three million people in the British Isles followed the King's example. Many prominent men, however, including high churchmen, leaders and geniuses in diversified fields of activity refused to take such a pledge, and it is rather interesting to read from a Bulletin issued subsequent to King George's fall from his horse:

"He (the King) is forced, however, during his convalescence to break his pledge to abstain from stimulants. His Majesty will resume his abstinence when quite restored to health."

The latest British Army regulations bearing upon the Use of Alcoholic Beverages was issued in

1914 under the official No. 34. This regulation reads:

"On very exceptional occasions, as when the troops have been drenched or chilled through exposure of manœuvres or training, a free ration of half a gill of rum ( $2\frac{1}{2}$ oz.) may, if available, be issued under the authority of the G.O.C. when certified by the senior medical officer to be absolutely necessary for safeguarding the health of the troops."

It is now said that in spite of this Regulation, which requires that the rum ration is only to be used on "very exceptional occasions" and, therefore, intelligently in a pathological sense, it is now being given the troops regularly—a modification which is unfortunate from the standpoint of health and efficiency.

Absinthe, which has been designated as the most poisonous of all alcoholic beverages, has been prohibited in France as it was in Belgium in 1905, Switzerland in 1908 and Holland in 1910. The French soldier has recently been specifically warned against alcohol as the following appeal to the Army will show:

### **Soldiers—Beware of Alcohol**

"Those who, like you, are exposed to exhausting labor, to perilous enterprises, and to strong emotions, are ever inclined to look to alcohol as a stimulant and a comforter, and to seek for it in the tavern as a distraction from the monotony of cantonment and garrison life.

"It is, therefore, well that you should know what use you may make of alcohol without impairing your health.

"Certain errors about alcohol are wide-spread.

"1. It is said to give strength. This is not exact. The truth is, it gives a false spurt of short duration, but a grave diminution of strength never fails to follow this excitement. Thus alcohol takes away more strength than it gives.

"2. It is also said that alcohol gives warmth. This is true for a few minutes, but the feeling of warmth which spreads over the limbs after a nip of brandy is delusive and is soon

followed by a lessening of warmth and strength. Men who take nips are far more subject to chills and to diseases to which men at the front are liable.

"3. It is further asserted that in the form of a 'pick-me-up,' alcohol stimulates the appetite. This is quite wrong. It would be difficult to produce any man whose appetite had ever been really stimulated by a 'pick-me-up.' These apéritifs, habitually taken, lead without fail to disease of the stomach, liver, and mind.

"4. Lastly, it is maintained that alcohol taken during meals, as wine, beer, or cider, aids digestion. An important distinction must be drawn between 'distilled' liquors like brandy and 'fermented' liquors such as wine, cider, and beer. Alcohol is altogether noxious. The *petit verre* after meals should only be taken on rare occasions. Fermented liquors, on the other hand, may be drunk subject to two conditions. They must be consumed in great moderation, which, as regards wine, should never exceed one liter (a pint and three-quarters) in twenty-four hours, and only at meals."

The preamble and the first three paragraphs of this appeal were adopted, we are told, by the Academy of Medicine in Paris, without controversy, but the fourth paragraph, in which a distinction is drawn between distilled and fermented beverages, was the subject of much discussion. As originally proposed it appears that the paragraph contained after "aids digestion" the words "this is true," and these words were finally omitted. The original draft did not contain, apparently, the last half of paragraph 4 but merely stated that fermented beverages might be useful.

Despite the estimate of abstinence in regard to alcohol as promotive of war efficiency, expressed by the German Emperor in his Murvik address, we learn that the only German Regulatory Measures in regard to alcoholic beverages are those prompted for economic reasons, such as the order limiting the quantity of hops which may be used in the manufacture of beer. Kaiser Wilhelm deprecates the use

of alcohol by the German fighting forces, but the German soldier is allowed 1,793 grams of beer and 20 grams of brandy per day, which is equivalent to 70.7 grams of actual alcohol daily, and the German Imperial Chancellor, Dr. Von Bethmann Hollweg said in reference to the Alcohol Prohibition Movement, and particularly as exploited in America, "A movement of that sort would make no headway in Germany. The people would regard it as an absolutely unwarranted interference with their personal liberty." Germany has the most efficient and at the same time the most centralized form of government which now exists, yet we are told that her people, dominated by despotic militarism and autocratic paternalism, would refuse interference affecting their personal habits and liberty along lines which many Americans, boasting of their democracy and freedom, consider quite proper for State or Federal Prohibition Legislation.

### **Alcohol in the Navy**

The recent controversy between Secretary of the Navy Daniels, and Rear Admiral Fiske in regard to the Daniels "Wine Mess" order, has shown in an interesting manner the fanaticism of the impractical prohibitionist and the views of the experienced Naval officer, who voiced the opinions of "more than 95 per cent. of the officers of the Navy, including many officers who are total abstainers and not excluding chaplains of experience." Admiral Fiske states that the evil effects of the abolition of the "canteen" in the Army are well known and an official attempt at absolute prohibition on board ship and at Naval Stations would be a serious mistake. Admiral Fiske is an advocate of the moderate

and occasional use of wine and beer on board ship for those who desire it. Spirituous liquors—with large alcoholic content—have been forbidden on the ships of the Navy since 1863. Before the Daniels Prohibition Order went into effect, an enlisted man was allowed one bottle of beer, but only one, if taken with his dinner. Admiral Fiske says, "I have never known a case of drunkenness aboard ship due directly to the beer or wine mess." He also is of the opinion that there are certain temperaments which seem to desire or crave some narcotic, which are satisfied with mild alcoholic beverages taken at opportune times and in a way that does not seem to detract in any degree from their efficiency; if such men are deprived of an occasional comparatively harmless drink, they will when the opportunity for taking stronger and more harmful drinks presents itself, avail themselves of it and most probably indulge in strong alcoholic liquors to excess. "Another effect," says Admiral Fiske is, "an increased temptation to use cocaine and other drugs. This danger is real—not imaginary. Many people crave stimulants of some sort and if they cannot get what they prefer, will take anything they can get. Cocaine takes up little space and is very convenient. Its use among enlisted men has increased since they were prohibited the daily bottle of beer." The records of the Navy show that during the years immediately before and after the Daniels "Wine Mess" order went into effect, the number of convictions for drunkenness was the same. The order did not reduce excessive drinking—it probably much increased it and it did a most deplorable thing in encouraging officers who desired some alcohol to conceal spirits or drugs in their rooms, exercise deceit

and partake "on the quiet"—the first pronounced step in depravity and a phase of dishonesty which is allied with and may drift into more vicious forms of falseness. But there is another phase which affects the manhood and liberty of the individual. "To hold our officers up to the country as a body of men lacking in self-control would be to strike directly at their dignity as men and lower their pride in themselves and there calling. The enthusiasm and cheerful obedience necessary to the best efficiency have never been attained by such methods—they may be relied upon for initiative and zeal if their pride in themselves is not weakened."

### **Russian Vodka**

One-fourth of the entire revenue of the Imperial Russian Government was practically wiped out as a result of the far-reaching effects of the recent Ukase, and the Tsar's public declaration that he has "decided to abolish forever the Government sale of vodka in Russia," for "We cannot make our fiscal prosperity dependent upon the destruction of the spiritual and economic powers of many of my subjects." This does not necessarily mean that prohibition of the vodka traffic in Russia is to be made permanent, but it does mean that the Government traffic in the same is at an end. The death warrant of one of the most blighting and soul-destroying monopolies the world has ever known, has apparently been executed. It is not pleasing to say that the deplorable, unnecessary and inane war now waging in Europe can be productive of any good, but we are compelled to affirm that the war has brought about some good to the toilers and peasant classes of Russia by the removal of the curse, not so much

of vodka, as of vodka exploitation and tax collecting. The collection of the Russian Spirit Tax was let by contract to tax farmers whose profits depended upon the amount of spirits consumed in their district. As a result, these tax farmers encouraged the vodka habit among the peasants and there were not wanting instances of the police belaboring peasants because they would not get drunk. An instance is related by Pigott in his book on "Savage and Civilized Russia" where the police stood over the peasants in a public house and by force of blows compelled them to buy and drink spirits. The exasperated peasants finally, drink crazed, demolished the building, but the Government ordered that no notice be taken officially of the incident.

"The tax farmer lays on a great addition to the legal price of the spirit; and to secure connivance he bribes all the local officials. To repay himself the expenditure of hundreds of thousands a year in bribes and to make the people drink as much vodka as they would if it bore the legal price, all conceivable devices of intimidation and seduction are employed to get a certain quantity of liquor down men's throats, and up in score against them. There are no fouler nests of crime than Russian public houses; laws and ordinances never enter them. The collectors of the vodka duty keep the police in their pay; and the police never interfere when the sale of liquor is going on."

Vodka in Russia literally means "Little Water," and has a contemptuous and sinister meaning. The consumption of spirits in Russia during the last year of the monopoly aggregated 354,141,000 American gallons, and there were in existence in 1912, 2,983 distilleries. Russian statistics showed that for each thousand people there were 266.9 deaths of children under one year old, 582 under five

years and 629 under ten years of age,—a ghastly record of infant and child mortality!

In a paper read at Milan, Italy, in September, 1913, Nicholas de Cramer showed that in the year 1906 there was one registered drunkard to 16,962 inhabitants in Paris, to 1,020 inhabitants in Vienna, to 329 inhabitants in Berlin and to 25 inhabitants in Petrograd. In the Government of Pskov, investigation showed that 83 per cent. of the boys in the schools and 68 per cent. of the girls drank vodka. In Moscow these figures were 66 and 45 per cent. respectively; in the Government of Saratov 79 and 48.5 per cent. and in the schools of Ekaterinodar 63 per cent. of the children were users of vodka. School children were also employed in the distilleries in Russia and in many cases their wages were partly paid with vodka. In Krapvensk where the public school and the state distillery are in very close proximity, the number of children receiving vodka for their work was 55 per cent. of the number of pupils in the school.

The Russian Minister of Finance recently said, "Notwithstanding the depressing and paralyzing effect of the war, the Russian peasant class is more prosperous than at any previous time in the history of the country. . . . instead of feeling any privation . . . the people are beginning to regard the war as a peculiar sort of godsend which is putting money into their pockets. . . . It is the prohibition of the sale of vodka which is primarily responsible for the ameliorated conditions of the peasant. The sieve through which all the available earnings formerly disappeared has now been closed and the money is either spent for present necessities or is saved for future wants." M. Bark

should have gone further and said that the Russian Government, in the interest of National Safety, had been forced, because of the war with its economic problems and the deplorable conditions of the lower and agricultural classes, to abandon their despicable, vicious system of raising revenue with vodka and thus sacrificing the health, morals and prosperity of the people through their coercive and tyrannical methods. The Russian peasantry are happier and more prosperous than ever before because they are enjoying a little of the fruits of freedom and experiencing less of the horrors of a despotism that seemed to glory in keeping the lower classes poor, ignorant and drunk. The Russian Vodka Ukase was the abolition of a depraved form of slavery and with the reduced consumption of strong spirits, it has increased the producing power of the people and stimulated their loyalty. It is also possible now to raise armies, enforce discipline and make soldiers. Was not the Russian autocracy fearful of vodka breeding mutiny among the armed and oppressed forces of the Empire? There were many reasons other than the true welfare of the public that caused Grand Duke Nicholas, Commander of the Russian Troops, to expel vodka from his military jurisdiction, and the Tsar to sanctimoniously announce later the suspension of Government manufacture and sale of vodka. The savings deposited in one month are now said to be 50 per cent. more than the average yearly savings during the period when the Government squeezed its revenue from the suffering poor and ignorant by forcing them, through the medium of a diabolical tax-collecting system, to drink excessively a poisonous decoction which the law stipulated could not be

sold unless it contained at least 40 per cent. of alcohol.

The Russian Ukase affecting vodka and strong spiritous liquors, will save the people, it is estimated, about a billion dollars per year. No wonder Mr. Scherbatskoy of the Russian Embassy at Washington recently remarked with enthusiasm, "Its benefits (Vodka Ukase) have exceeded even the most sanguine expectations—the benefits from the policy are great enough to completely compensate for the loss of the revenue many times over." And Lloyd George has said, "By suppressing the sale of alcoholic liquors, Russia has increased the productivity of her labors by something between 30 and 50 per cent."

How deplorable the conditions of society must be in some lands, when freedom from a Government curse can only be obtained when the workings of governmental depravity in an unprecedented emergency are conspicuously seen to rob men of soldierly essentials, undermine the military and economic strength of the nation and make a tremendous Empire vulnerable, with feet of clay.

### **Various Kinds of Alcohol**

The alcohol found in beer, wine and spirits is ethyl alcohol (common or grain alcohol). It contains 52.67 parts of carbon, 12.90 parts of hydrogen and 32.43 parts of oxygen, and is made by fermenting a sugar solution with yeast in the presence of nitrogenous substances. When the proportion of pure alcohol in fermented liquors becomes 13.5 per cent., its poisonous quality kills the yeast plant which produces it and stronger liquors must be produced by distillation. There are other kinds of

alcohol but with the exception of methyl, or wood alcohol, they are mainly of interest as impurities of the preparations of ethyl alcohol which they all resemble in their general effects but differ from in toxicity. Propyl alcohol is more powerful than ethyl, butyl than propyl and amyl than any of them. Amyl alcohol, or fusel oil, is present in small quantities in most forms of spirits and is extremely deleterious and poisonous.

Many serious cases of poisoning have been reported as a result of the wilful or ignorant use of methyl (wood) alcohol as a substitute for ethyl alcohol. Methyl alcohol intoxicates but its action is slower than ethyl and the depression or narcotic condition more prolonged. It is not, however, readily excreted and fully oxidized; its products in the body are formic acid and formaldehyde and it is thought that these substances, or perhaps acetone and other bodies always present in the commercial article, may account for its especially deleterious effects which are apt to lead to atrophy of the optic nerve with permanent blindness and depression of cardiac and voluntary muscles, resulting in death. Many cases of severe illness, blindness and death have been known when the wood alcohol of commerce has been taken by men deprived of the use of alcoholic beverages, and many cases have been reported where cheap vicious spirits made with methyl alcohol have been sold by unscrupulous manufacturers and dealers. After one celebration on doctored spirits at Dorpat, Russia, 16 men and one woman died and 3 men became blind. At Stryker's Farm, near New York, 25 died from drinking a cheap whiskey made of methyl alcohol. In the Berlin Municipal Lodging House, during Decem-

ber, 1911, there were 70 sudden deaths due to wood alcohol in cheap spirits. Buller and Wood collected the records of 54 cases of blindness in this country, some of which ended fatally, due to the use of methyl alcohol. Deaths from wood alcohol have usually followed debauches with adulterated whiskey, and spirits of this type are common in prohibition territories. Many instances of severe poisoning and blindness have come from the drinking of hair-tonics, bay-rum, cologne waters, essence of ginger and other pharmaceuticals in which wood alcohol has been substituted for ethyl alcohol. A large number of pharmaceutic preparations contain alcohol either as a solvent or preservative, and certain proprietary remedies with a large content of alcohol have tremendous sales. Such liquids are often taken as an alcoholic drink in states where alcoholic beverages are not readily obtainable, and Bastedo says, "Women habitués frequently drink in secret and many consume large quantities of eau de-cologne, Florida waters, witch-hazel or some proprietary medicine."

### **The Prohibition Movement**

The Prohibition Movement in the United States is a somewhat hysterical un-American Movement. It is opposed in principle to the Constitution of our country. L. Ames Brown truly says, "The typical American will be slow to forget the lessons of the growth of our liberty nor will he be willing, for a purpose not well weighed, to abandon anything of the progress we have made. He is not likely to overlook the fact, that in asking the Federal Government (or the State) to compel moral and physical well-being through prohibition, the country

will be turning back to the older idea of government to which the democratic ideal offered its thrilling challenge some two centuries ago. A doctrine of salvation through the removal (or hiding) of temptation, of righteousness made possible by lack of opportunity for sinning, such as the Prohibition Movement represents, never has been typical of the American character. Rather have we believed that the robust tone of our national character was achievable only through the resistance of those elements which assailed it. American character has no negative quality. Established superiority to hardships and temptation has been its most admired attribute. The philosophy of sinless isolation has had few protagonists among us. One way to a sinless life lies through the cloister. Some close resemblance to this is borne by the prohibition of temptation."

Prohibition is not the remedy which we should attempt to apply to intemperance. Measures and propaganda to combat the evil effects of alcohol should be chosen that are more effective and more consistent with our fundamental ideas of democracy and freedom. *The saloon will be eliminated, drunkenness will be reduced and temperance or abstinence, with increased human efficiency, will be achieved by education and regulatory measures in harmony with the tradition and ideals of democratic individualistic government.* In our Prohibition States, alcoholism persists and this often with accompanying increased degeneracy—deceit, drugs, vile and strong liquor and excessive drinking when the opportunity for imbibing presents itself. There is less drunkenness and vicious intoxication in many of our "wide-open," large cities than exists, considering the population numerically, in many of our

Prohibition districts, countries and states. New York City is far more temperate than it was even a decade ago. A down-town business lunch without alcohol in some form or other was unusual two decades ago; now such a lunch with alcohol is as unusual and conspicuous as it used to be common. This gradual change is the result of diffusive knowledge which has carried the conviction to business minds that alcohol is a lessener of efficiency and a man can perform better work without it. The American Movement looking toward efficiency, with scientific investigations showing the relation of cause and effect and not the semi-religious Movement, with the pulpit serving as the prohibitionists' stump, is the cause of increasing temperance among our thinking citizens.

According to available British figures, the mortality attributed to alcoholism reached its highest during the period 1896 to 1900 when 106.2 men per million and 66.6 women per million suffered death from alcoholic excesses. These figures were reduced a decade later (1906 to 1910) 37.3 per cent. for men and 34.5 per cent. for women, without legislation or any serious prohibition propaganda other than that of education. Prior to the war it is said that additional steady gains were being made in the interest of temperance and teetotalism.

Sane regulation will handle the question of alcohol out in the open, but Prohibition drives it to the under world of vice, deception, law-breaking, drug-taking and moral death. We need conservatism in dealing with the questions affecting our life and liberty lest our habit of forming hasty conclusions, our passion to reform our neighbors, and our tendency to make new and absurd laws pro-

lifically and with hysterical speed, rob us of our boasted democracy and that freedom and liberty which is the foundation of our Great Republic and the true cause of our National growth and prosperity.

For many years the Prohibitionists have waged aggressive warfare in this country "to make the map all white" and viewed from almost any angle, it must be admitted that while their efforts have been spectacularly successful in adding territory to their "white" domain, they have not succeeded in materially reducing the "drink evil" or of enforcing prohibition and making it effective. Over 77 per cent. of the area of our land, represented by 19 states, is now "dry" and 50.7 per cent. of our people are living under prohibition laws, and yet in the last decade the consumption of alcoholic beverages in this country has increased 13 per cent. per person and 33 per cent. in aggregate quantity. Each person on an average drinks about twice as much alcohol as was consumed per capita three decades ago.

The total consumption of alcoholic liquors in the United States as shown by the Official Statistical Abstract during the past few years is as follows:

Year	Total Consumption	
	in Gallons	Per Capita
1909	1,935,544,011	21.06
1910	2,045,353,420	22.19
1911	2,169,356,975	22.79
1912	2,128,452,226	21.98
1913	2,233,420,461	22.68
1914	2,252,272,765	22.50

If prohibition were effective the consumption of alcohol in this country should have been reduced

50 per cent. with one-half of its people living under prohibition laws. The American Prohibition Year Book for 1916, published by the Prohibition National Committee, admits that, "In spite of the 'white map' the liquor problem is diminishing neither in size, importance nor complexity. Considered from the standpoint of the area of territory legally 'dry' and the number of people living under prohibition laws, the methods so far widely used have been reasonably successful; *but considered from the standpoint of offering a real solution of the problem, that is, decreasing the consumption of liquor, diminishing the corrupting power and influence of the traffic—these methods have been a failure.*" (The italics are mine.)

The same official book says, "The 1915 statistics show a greater consumption of liquor practically equal to that of any previous year of our history. The latest available government reports show greater investments of money and more men employed in the liquor business and allied industries than any statistics heretofore published."

A telegraphic Press item from Washington, dated May 13, 1916, says, "Notwithstanding the fact that prohibition laws have become effective in seven states since July 1, 1915, approximately 7,500,000 gallons more whiskey have been used in the United States so far during this fiscal year, ending June 30, than ever before. Returns to the Internal Revenue Bureau approximate the total increase for the year at 10,000,000 gallons." During the same period the consumption of beer has been somewhat reduced, but the total consumption of alcohol for the year will most probably exceed that of the preceding year. Prohibition laws apparently

tend to increase the consumption of alcoholic beverages of high alcohol content, such as whiskey, and reduce that of the less harmful and milder drinks. The report of the Committee on Temperance of The General Presbyterian Assembly, May, 1911, says, "When all allowances are made for false and garbled statements, deliberate falsehoods, and misleading charges, the fact remains that there is an alarming increase in the use of alcoholic liquors in the United States as a whole. Only harm can result from deceiving the public by charts which indicate a rapid advance in temperance legislation and by boastful statements about making 'the map all white' while we are doing nothing of the kind." It is also ridiculous for prohibitionists to submit figures to show the lessening of crime, poverty, divorce and insanity in prohibition states as compared with licensed states. Present figures cannot be comparative with the past, for the world is advancing in knowledge, and disease is being combated more successfully by science. Poverty bears some relation to local and state prosperity and all physical and moral perversion are influenced by environment and the nature and hereditary stock of the inhabitants. Particularly in the West and the sections of the country now being "opened up" and developed, and in large manufacturing centers where unskilled labor is largely employed, the nature of the population changes rapidly. The calibre of the immigrant and the extent of the locating of new settlers materially affect the nature and mode of life of a community. Government statistics show that 14.7 per cent. of our population are foreign-born, and an additional 20.5 per cent. are native-born of foreign parentage.

Of the foreign stock—if such a term can be used in a nation of Mixed Races, dependent from the first upon immigration for its existence—69 per cent. live in the cities and towns. Our white male population, age 21 and over, in 1910, was 41 per cent. foreign-born, or of foreign or mixed parentage. This is equivalent to 73 per cent. of the total vote for President in 1912.

The native white population of native parentage in the United States is only 53.8 per cent. of the entire population. The states with the largest proportion of their population foreign-born are:

Rhode Island	33	per cent.
Massachusetts	31.5	“ “
New York	30.2	“ “
Connecticut	29.6	“ “
North Dakota	27.1	“ “
Minnesota	26.2	“ “
Montana	25.2	“ “

The rural population of the country represents 53.6 per cent. of the total, the extreme relationship between Rural and Urban population being represented by:

Percentage of Population		
State	Rural	
North Dakota	89.	} Maximum
Mississippi	88.5	
Connecticut	10.3	} Minimum
Massachusetts	7.2	
Rhode Island	3.3	

The immigration to this country during a century represents, in the aggregate, about 35 per cent. of the present population. During the fourteen years preceding the outbreak of the present war, the immigration of Europeans to the United States

equalled the combined population of the New England, the Pacific Coast and the Rocky Mountain states—13,255,207 people. As many as 1,285,349 immigrants have entered this country within one year, and the figure of 1,000,000 was exceeded in the years 1905-6-7-10 and 13. In this great “melting pot” of a nation, all nationalities, races, religions, beliefs and habits of life and modes of living can be found. There are 49 distinct religious denominations in this country and these are divided into 173 different and separate bodies with about 37,000,000 communicants. No one can estimate the effect of religious teaching upon the lives and habits of a people. America is a land of all climates, torrid, frigid and temperate; of all altitudes, low and flat, high plateau and mountainous; much land is fertile and well watered and much is arid; some sections have moderate variations of seasons and some are subjected to extreme variations of climate as expressed by temperatures, rain or snow fall and sunshine. With such extreme differences in nature’s setting and such diversified characteristics of its population, together with the ever moving human current peculiar to a New Land, it is absurd to make comparisons of the habits or morals of the inhabitants of different states, districts or cities. The bodily appetite for liquid is affected by temperatures and humidity, general environment and working conditions. The palatability and availability of pure, cool, refreshing water has a pronounced bearing on how the natural physical thirst will be satisfied. Physical health is also affected in no uncertain way by the natural adaptability of an individual to his environment; many a constitution is being undermined and forced to the condition

where it craves stimulants or narcotics because of the lack of harmony between a person's hereditary physical endowment and a climatic or geographical setting, to successfully cope with which the body was never created. No animal body can be modified or revamped except through the progeny of many generations, by the working of the inexorable law of natural selection and evolution operating through thousands of years. Education which will teach people where to live as well as how to live will do more for temperance and the advance of physical and moral health than all the semi-religious alcoholic campaigns and propaganda ever conceived or exploited.

### **Prohibition Not the Solution of Alcoholism**

History and true comparative statistics will verify the assertion that prohibition never reduces the extent of drunkenness nor suppresses the real evil of alcohol. The moral, financial, economic, physical or mental conditions of the people of a prohibition state are not on any higher plane than those which obtain in a licensed state populated by similar people living under identical similar conditions. On the contrary, "not only does the prohibition state harbor all the ills which flow from overindulgence in alcoholic drink but also many others which result from the use of inferior liquors and drugs." Many states have tried prohibition and have rejected it. Maine, Vermont, Connecticut, Delaware, Iowa, Massachusetts, Michigan, Nebraska, New Hampshire, New York and Pennsylvania are among the states which at one time adopted prohibition laws, but all of them abandoned these laws after a short time except Maine and in that state we have a glar-

ing exhibition of the hypocrisy of prohibition. Not the slightest pretense is made in many parts of Maine to enforce the prohibition law, and when the authorities are periodically active, the secret dive, "Kitchen Bar" and "blind tiger" are prevalent in all their viciousness, and at the last election it was proved that there is no true majority in Maine in favor of prohibition, notwithstanding the advantages gained by the prohibitionists in waging warfare through the churches and religious organizations. Every political campaign in the state of Maine has for one of its prominent questions the failure to enforce prohibition, and Maine's foremost citizens have vehemently denounced the law as a sham and a fraud.

Kansas is the model state of the prohibitionists and it is "model" because only 29.2 per cent. of its population is urban; there are no cities exceeding 100,000 inhabitants; 71.4 per cent. of its people are native whites, born of native white parents; only 8.6 per cent. of its population is foreign born, and out of 1,690,949 inhabitants in 1910 only 44,215 were wage earners engaged in manufacture. We find that in Topeka, the Capital, with 47,102 people (1914) there were 661 arrests for drunkenness during the year, and the Prohibitionist Advocate boasts that only 6,250,000 gallons of alcoholic beverages, valued at \$5,304,000 were consumed in Kansas during the year and not even druggists were permitted to dispense alcohol. Add to this the fact that the government records show that alcoholic drinks were manufactured within the state and many hundreds of dealers paid for Federal Licenses (766 on June 30, 1914), and prohibition within the "Model State" must be admitted as a travesty. There is, moreover,

a darker and more vicious side of the question, for alcohol in many forms was consumed in the aggregate within the state to an extent many times exceeding the estimates of the prohibition enthusiasts and this was taken deceitfully in many forms, some deplorably injurious, and in many places—some the worst forms of dives.

Wm. H. Hirsh in an address before the Joint Committee of the Legislature of the State of New York said:

“The mysterious workings of prohibition are amusingly and yet shamefully disclosed by the enactments which made Georgia a prohibition State. By one Act the laws of Georgia provide that it shall be unlawful within the limits of the State to manufacture, sell or offer for sale, keep for sale, barter, furnish or keep on hand at a place of business or at any social, fraternal or locker club, alcoholic liquors in any quantity. By another and supplementary act it is provided that a person may receive, accept delivery of, possess and have at one time, or within a period of 30 consecutive days the following quantities of alcoholic liquor: (1) 1 gallon of vinous liquor, (2) 6 gallons of malted liquors or fermented liquors, such as beer, lager beer, ale, porter, etc., (3) 2 quarts of spirituous liquors or other intoxicating liquors. In other words, the prohibition laws of the State of Georgia provide that each individual may import for use each year 6 gallons of whiskey, gin or rum, 12 gallons of wine and 72 gallons of beer, ale or porter. That is, in this prohibition State, the law permits its inhabitants to have per capita 4 times as much whiskey, 19 times as much wine and  $3\frac{1}{2}$  times as much beer as is consumed by the average of the population of the United States. This is indeed a striking admission of the inefficacy and absurdity of prohibition. The mere presentation of the situation worked out by the law makers of Georgia is a complete acknowledgment that prohibition is not expected to prohibit.

“The experience of half a century shows that all efforts to enforce prohibition laws have proven futile and fruitless.

Liquor is dispensed in all States where prohibition laws exist, and crime, pauperism and insanity have been just as prevalent in those States as in States where it is sold under license, and according to statistics, in some instances more so. The prohibition State suffers the tremendous disadvantage of losing the great revenue which is derived under the license system, and also the control over the traffic which results in enforcing a license law."

Mr. Hirsh also asserted that prohibition legislation is wrong, being founded on false principles, and, moreover, its advocates are striving through theories to attain what is a practical impossibility. Sumptuary laws do not furnish the solution for the faults of society. They may interfere with the personal habits of man, embarrass and annoy him and under certain conditions function to his detriment and not as hoped to his benefit, but they can never make the foolish wise, the feeble strong, the wicked virtuous nor the toper abstemious. American liberty ends where arbitrariness begins. "If America is to continue a republic, its people must avoid too much personal government and not depart from the traditions and principles of old which left every man free to make the most of his life with a minimum of interference from government authority."

Koren has truthfully said that there are no legal formulae by which men can be made sober. "The prohibition doctrine of coercion has failed because it postulates that the habits and appetites of mankind are amenable to regulation after the manner of some inanimate mechanism; and mistaken attempts at wholesale reform entail more social breakage than salvage." The final element in considering the relation of prohibition to government is how its non-enforcement affects the public mind.

In the report of the investigation of the Committee of Fifty we read, "There have been concomitant evils of prohibitory legislation. The efforts to enforce it during forty years past have had some unlooked-for effects on public respect for courts, judicial procedures, oaths and law in general, and for officers of the law, legislators and public servants. The public has seen law defied, a whole generation of habitual law breakers schooled in evasion and shamelessness, courts ineffective through fluctuations of policy, delays, perjuries, negligences and other miscarriages of justice, officers of the law double-faced and mercenary, legislators timid and insincere and candidates for office hypocritical and truckling and officeholders unfaithful to pledges and to reasonable public expectations. Through an agitation which has always had a moral end, these immoralities have been developed and made conspicuous."

Arizona now proudly claims to have taken the highest moral stand of any state that has passed a Prohibition Law, in debarring the use, sale, manufacture or importation of spirituous liquor *for any purpose whatsoever*. Monahan commenting on this un-American law has said, "There are indeed some persons who take the view that, in so enacting, Arizona entitled herself to the Booby Prize; and it certainly has advertised her peculiar brand of statesmanship to the world at large." Aside from the great need of alcohol at times for pathological purposes it is supposedly an indispensable element for sacramental purposes in certain churches. A Catholic priest writes to the Fortnightly Review of St. Louis that his colleagues will be obliged to discontinue saying mass or take the risk of obtaining

wine surreptitiously. Arizona apparently believes that the Roman Catholics should get along with grape juice or some soda fountain decoction and some religious enthusiasts believe that the law was drawn with malice prepense to harass the Catholics—a curious object lesson of American liberty and toleration.

Expert lawyers believe that the Arizona Dry Law is violative of the religious liberty guaranteed by our constitution and so the Bishop of Tucson proposes to take the question to the highest courts. "That he may succeed," one of our greatest literati and true *temperance* advocates has said, "is the hope of all who hate to see a sovereign state turned over to the control of a set of fanatics and deeply muddled millenarians." No people in the world prate so much about liberty as we Americans and none are so apt to abuse it. Arizona is the headquarters for the fanatics who maintain that Christ in His first recorded miracle turned water not into wine as the Bible (which they claim to unfalteringly and absolutely believe) distinctly says, but into unfermented, non-alcoholic grape juice. The hysterical mania of self-professed religious people to strive, agitate and legislate for what they are pleased to term righteousness is being decidedly overdone, and when such activities affect the liberty of a conscientious American of broader or merely different views, they tend to rob him of his most cherished and inalienable right.

#### **Education the Solution of Alcoholism**

The habitual or excessive use of alcohol is costly. The consumption of alcohol is a source of great revenue to the nations but the cost is in men—in

their shortened lives, increased suffering and lessened efficiency. Alcohol is of much use in the world but its improper, habitual or excessive use as a beverage is one of humanity's greatest curses. Sentimentalists cannot cope with the evil and the law has failed and will continue to fail to do so. The solution of the problem lies only along lines of intelligent education and scientific helpfulness, freed from all bias and the hysterics which are generally associated with the prohibition and similar semi-religious and reform movements of to-day.

Those who persist in maintaining that alcoholics must be treated as criminals are so ignorant and short-sighted that they imagine that the cure for such degeneration lies in penalization, enforced confinement and compulsory abstinence. A man suffering with alcoholism is a sick man, an invalid, a diseased person and his treatment as a criminal intensifies his illness, tends to accelerate his moral degeneration and being subjected to enforced abstinence, his system is apt to be abused by a reaction from compulsory virtue from which he may never recover. The man who has permitted his body to be saturated with alcohol, whose system is used to it and demands it, if suddenly deprived of it, is forced into a most deplorable and pitiable condition and subjection to the inhuman present method of handling the disease—deprivation and penalization—usually results in delirium, a "wet brain," prolonged psychosis or permanent insanity.

Charles B. Towns who has had great success in treating unfortunates addicted to drugs and alcoholic habits, says, "It is exhaustion or lack of alcohol which first produces delirium in an alcoholic case, whether that exhaustion is due to the patient's

inability to assimilate food or alcohol or whether it is due to the fact that, being under restraint, alcohol is denied him. In most cases there is no form of medication which can be successfully substituted for alcohol and unless definite medical help is provided for the purpose of bringing about a physical change and thus avoiding delirium, no course remains safe except a long and very gradual reduction of alcoholic poisoning."

The treatment of alcoholics should be a gradual unpoisoning of the body. Experts, moreover, are of the opinion that if alcoholics were treated intelligently as patients, even after they have reached the stages of the disease where the mind is becoming affected, "the number of supposedly permanent cases of insanity arising from alcoholic and drug addictions might be decreased by 75 per cent." Neglect and abuse of the chronic alcoholic is almost universal and often considered commendable and proper by a thoughtless society which, if it does depart from time honored indifference or censure, generally wallows in a still more dangerous attitude of incredible and continued error, ignoring or defying science, research and fact.

Many authorities believe to-day that a large percentage of those unfortunates afflicted with insanity attributed to drugs and alcohol, were permitted to drift or were forced into this deplorable condition by improper diagnosis of their condition and its causes, followed naturally by improper medical treatment. A lack of definite or intelligent help in cases of chronic alcoholism is apt to bring about brain lesions which eventually result in hopeless insanity. It is well known that chronic alcoholism has been and continues to be the chief contributor to

the army of the insane, and in our asylums its presence is notably frequent among the violent cases. The records show that 40 per cent. of the insane in the asylums of New York have a definite alcoholic history, and one-third of all the patients admitted to Bellevue Hospital in New York City are sent there by alcohol.

Much intelligent work is being done in the treatment of tuberculosis but the victims of alcoholism receive, not curative methods or scientific consideration, but only condemnation and punishment, yet there are said to be forty alcoholics to every consumptive. Towns says, "By merely depriving an alcoholic of alcohol without eliminating his desire for it, we are likely to force him into something worse. Thus the attempts to enforce abstinence upon the man who wants to drink is not only ineffective but destructive." In his book on "Habits That Handicap" Towns tells us that the late Dr. Grinnell, Dean of the Vermont Medical College, after Vermont's adoption of prohibitory alcoholic legislation, sent out to the wholesale and retail stores throughout the state, that carried drugs as a part of their stock, a letter in which were enclosed blanks calling for specific information concerning the sale of habit-forming drugs. Such was his personal standing in the state that he received responses from all but two or three of those whom he addressed. The replies received indicated that the sales of drugs had swelled rapidly until they had reached a daily consumption equal to  $1\frac{1}{2}$  grains of opium or its alkaloids, for every man, woman and child in the state. This vast increase in the use of dangerous drugs was attributed solely to the prohibition of the sale of alcoholic beverages. Here is a definite illustration

to prove that the attempt to enforce abstinence upon the man who wants to drink is not only ineffective but destructive. Society, by laws of Prohibition, may or may not succeed in reducing the number of drunkards—underground drinking of bad spirits continued in Vermont as in other prohibition states and districts, in a vicious manner—but such laws are most likely to produce “drug fiends” and increase the number of lunatics and degenerates.

Any person suffering with alcoholism is in an abnormal physical and mental state and the only chance for cure lies in the reestablishment of natural conditions that make for health, the gradual unpoisoning of the abused system, the protection of the individual’s self-respect and the regaining of his confidence in himself. Punishment of the alcoholics causes humiliation and breeds rebellion. Reform cannot come from condemnation and society’s treatment of the drunkard arouses his resentment and not his repentance.

It is amazing to note the general attitude of certain Christian churches toward the alcoholic. A religious publication on “Temperance,” which would be more rightly named “Prohibition,” says that a man’s first offense in partaking of too much alcohol “deserved severe punishment for he was entirely responsible for his condition, and when he deliberately surrendered his will and intelligence to alcohol, the fool and murderer, he accepted the chance of grave crimes.” The scientist or sociologist who preaches education, helpfulness and intelligent mental and physical treatment in such cases, is substantially expressing, in a practical manner, the spirit of Christ whose mission was to save and not to condemn. Alcoholics should be given

definite treatment as sufferers of a disease caused by an unnatural mode of life, erroneous food with its improper nourishment and injurious thoughts. Alcoholism may result from an unstable nervous organism bequeathed by intemperate or abnormal ancestry or acquired by improper nourishment, poverty, overwork, physical abuse, grief or worry. Some systems crave excitement and exhilaration, and there are alcoholics who possess "many qualities of mind and temperament which the world admires and pronounces of the utmost value when rightly developed."

In these days of unnatural living with human activities and the pressure of existence out of harmony with the biologic man, the so-called civilized and highly developed man inevitably searches and craves instinctively for exhilaration and stimulants to cope with the artificial social systems with which progress has enveloped him. Towns truly says, "We work beyond our strength and naturally feel the need of stimulants; we play beyond our strength and as naturally need whips for our vitiated energies. All humanity turns in one way or another to artificial stimulants and while alcohol and narcotics are the worst among these, we cannot slur the fact that many who shun these agents as they would a pestilence, turn freely to milder but not altogether harmless stimulants, such as tea, coffee and tobacco." Dr. W. A. Evans has also said, "In order that no misunderstanding may arise, I should say that physiologists regard coffee, tea, tobacco and whiskey as drugs in the same sense as opium and cocaine. From coffee at the one end of the line to cocaine at the other, no pot has the right to call the kettle black."



# Theoretical Fuel Value of Alcoholic Beverages

Beverage	Portion	Quantity	Alcohol Per Cent. By Weight	Total Extracts Per Cent.	Total Fuel Value Calories
<b>A. DISTILLED LIQUORS</b>					
Pure French Cognac Brandy	Cordial Glass	20 c.c.	55.90	.02	78
Dry Martini Cocktail	Cocktail "	75 "	21.30	6.21	131
Gin	" "	50 "	30.00	5.50	116
Benedictine	Cordial "	20 "	42.40	35.00	98
Chartreuse	" "	20 "	35.20	35.40	78
Curacao	" "	20 "	42.00	27.90	82
Crème de Menthe	" "	20 "	36.50	28.28	74
Jamaica Rum, pure	" "	50 "	69.61	.61	245
American Whiskey, genuine	" "	50 "	43.00	.70	152
European Whiskey	" "	50 "	39.00	....	137
<b>B. WINES AND CIDERS</b>					
<b>1. American Wines</b>					
California, red	Claret Glass	120 c.c.	9.50	3.10	95
California, white	" "	120 "	9.00	2.70	89
California Port	Sherry "	30 "	14.81	12.17	53
California Sherry	" "	30 "	14.67	5.53	38
<b>2. European Wines</b>					
Champagne, dry	Champagne glass	135 c.c.	10.42	2.36	112
French, red (claret)	Claret "	120 "	8.16	2.42	81
French, white	" "	120 "	9.48	3.03	96
Mosel and Saar, white	" "	120 "	7.36	2.31	73
Rhein wine, white	" "	120 "	8.12	2.91	83
Champagne	Champagne "	135 "	9.50	12.88	161
Madeira	Sherry "	30 "	15.40	5.52	39
Malaga	" "	30 "	11.93	21.73	52
Marsala	" "	30 "	15.85	5.28	40
Port	" "	30 "	16.69	8.05	45
Sherry	" "	30 "	17.45	3.98	42
Tokay, fresh	" "	30 "	11.19	12.72	39
<b>3. Ciders</b>					
American, sweet	Glass	250 c.c.	1.40	8.20	109
American, fermented	"	250 "	5.17	3.88	130
<b>C. MALT LIQUORS</b>					
<b>1. American</b>					
Ale	Glass	250 c.c.	6.02	4.86	155
Lager beer, bottled	"	250 "	4.53	4.96	130
Lager beer, draft	"	250 "	4.27	4.40	120
Porter	"	250 "	4.46	6.00	140
<b>2. European</b>					
Ale	Glass	250 c.c.	5.27	5.99	154
Bock Beer	"	250 "	4.20	7.10	146
Export Beer	"	250 "	4.29	6.50	142
Light Beer	"	250 "	3.69	5.39	120
Munich, heavy beer	"	250 "	4.54	9.96	132
Pilsen, export beer	"	250 "	4.28	4.69	123
Porter (Stout)	"	250 "	5.16	7.97	172

The alcoholic with stomach inflamed and nervous system undermined; the tea sot, shrivelled and poisoned, with nerves keyed up to the snapping point; the coffee toper, sallow and bilious, with blood poisoned and nerves adrift; the smoke fiend persistently loading his system with an intensely poisonous alkaloid, are all the result of the unnatural demands of life and the influence of an artificial environment—an existence for which the human constitution is not properly attuned. We may go further and say that a person may be unduly exhilarated by faulty dieting; there is such a thing as food intoxication and “beef steak jags” with auto-intoxication, blood poisoning and uric acid troubles the “morning after.” All forms of intoxication are due to violation of nature’s laws of nourishment and adaptability. Our lives are not in harmony with nature, therefore, instead of “doping” ourselves to endeavor to do or withstand unnatural things which at times seem to be the line of least resistance and give the quickest ensuing benefit, we should learn what nature’s laws can teach us. For the promotion of health in our peculiar, opposed setting, we should partake of nature’s bounty, adopt and select from the “good things of life” only those which make for health and usefulness—for in these are included happiness, success and longevity.

Alcoholism and all other kindred vices of a strenuous and artificial social existence will be overcome only by education, by the upbuilding and development of the human body—physiologically and psychologically, by the elimination of injustice from the world where science and helpfulness will take the place of prejudice, ignorance and vengeance and by

# Theoretical Fuel Value of

Beverage	Portion		
<b>A. DISTILLED LIQUORS</b>			
Pure French Cognac Brandy	Cordial Glass		
Dry Martini Cocktail	Cocktail "	1.50	1.50
Gin		1.50	1.50
Benedictine	Cordial "	1.50	1.50
Chartreuse	" "	1.50	1.50
Curacao	" "	1.50	1.50
Creme de Menthe	" "	1.50	1.50
Jamaica Rum, pure		1.50	1.50
American Whiskey, genuine		1.50	1.50
European Whiskey		1.50	1.50
<b>B. WINES AND CIDERS</b>			
<b>1. American Wines</b>			
California, red	Claret Glass	1.50	1.50
California, white	" "	1.50	1.50
California Port	Sherry "	1.50	1.50
California Sherry	" "	1.50	1.50
<b>2. European Wines</b>			
Champagne, dry	Champagne glass	1.50	1.50
French, red (claret)	Claret "	1.50	1.50
French, white	" "	1.50	1.50
Mosel and Saar, white	" "	1.50	1.50
Rhein wine, white	" "	1.50	1.50
Champagne	Champagne "	1.50	1.50
Madeira	Sherry "	1.50	1.50
Malaga	" "	1.50	1.50
Marsala	" "	1.50	1.50
Port	" "	1.50	1.50
Sherry	" "	1.50	1.50
Tokay, fresh	" "	1.50	1.50
<b>3. Ciders</b>			
American, sweet	Glass	1.50	1.50
American, fermented	"	1.50	1.50
<b>C. MALT LIQUORS</b>			
<b>1. American</b>			
Ale	Glass	1.50	1.50
Lager beer, bottled	"	1.50	1.50
Lager beer, draft	"	1.50	1.50
Porter	"	1.50	1.50
<b>2. European</b>			
Ale	Glass	1.50	1.50
Bock Beer	"	1.50	1.50
Export Beer	"	1.50	1.50
Light Beer	"	1.50	1.50
Munich, heavy beer	"	1.50	1.50
Pilsen, export beer	"	1.50	1.50
Porter (Stout)	"	1.50	1.50

# Report of the Board of Directors

For the year ending  
December 31, 1907  
of the Board of Directors

1907	1906	1905
1906	1905	1904
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Report of the Board of Directors  
for the year ending  
December 31, 1907

Report of the Board of Directors  
for the year ending  
December 31, 1906

Report of the Board of Directors  
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December 31, 1905

Report of the Board of Directors  
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December 31, 1904

Report of the Board of Directors  
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December 31, 1903

Report of the Board of Directors  
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Report of the Board of Directors  
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December 31, 1901

Report of the Board of Directors  
for the year ending  
December 31, 1900

Report of the Board of Directors  
for the year ending  
December 31, 1899

Report of the Board of Directors  
for the year ending  
December 31, 1898

the gradual crowding out of poverty and fear. When the human race becomes adapted to the life it leads, by the development and perfecting of the nervous system, by knowledge of the laws of nourishment, with due consideration for strength, endurance and the wear and tear of the physical organism and by the adoption of sane "speed and pressure laws" of mental activity with prescribed periods for recuperation, then, with education showing the truth and eliminating poverty, will come a true balance in life where alcohol and kindred drugs will be used pathologically and judiciously for the virtue that is in them and not diabolically as pleasurable drinks to drown the evils and thoughts of life. Education and natural living will eradicate alcohol and vice from society—prohibition laws never will. Education will produce a race of men and not weaklings who will handle masterfully the products of nature to their benefit, scorning to have their manhood enslaved to their detriment.

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Etc., Etc.	

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W. A. F.



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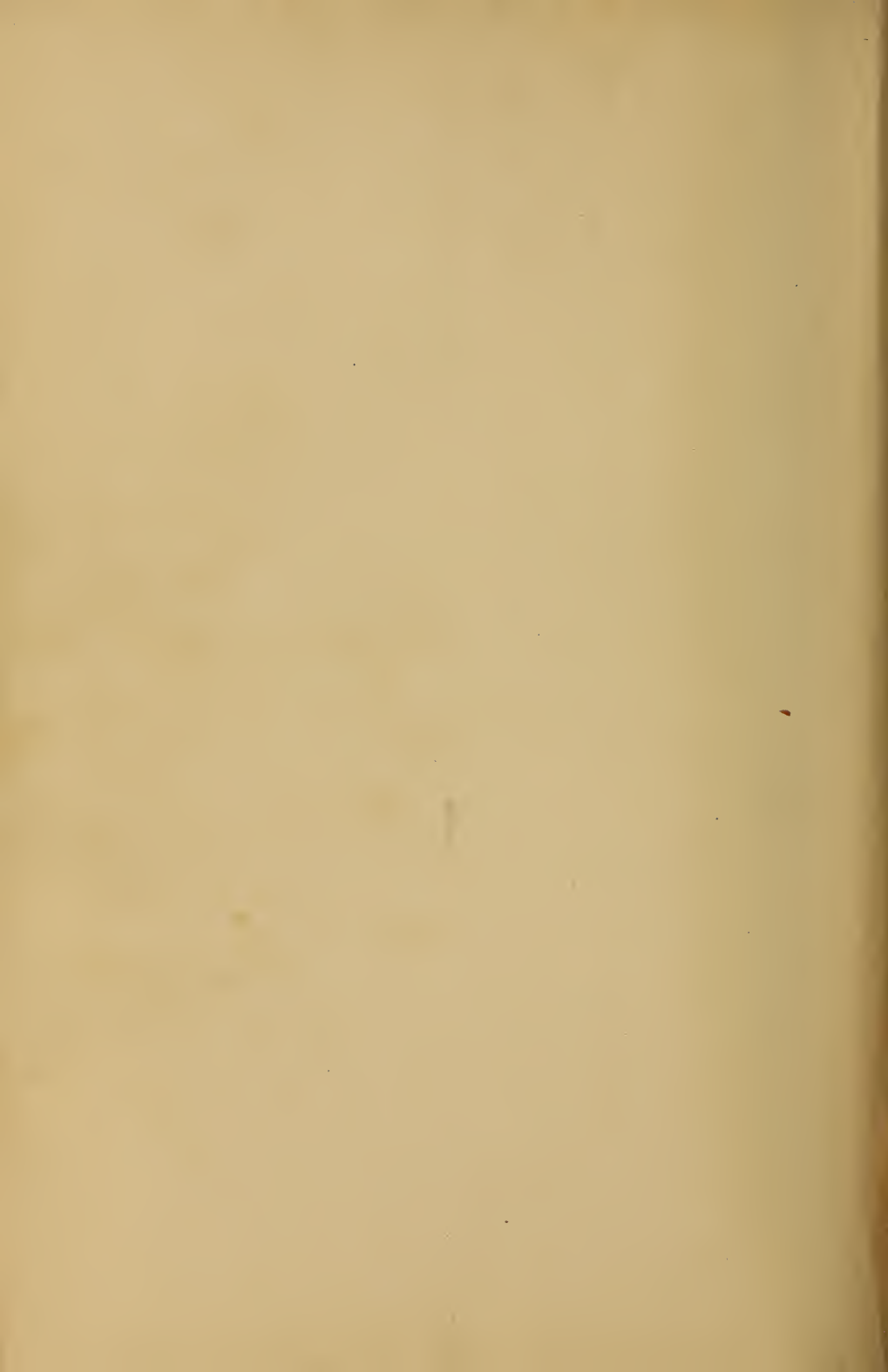
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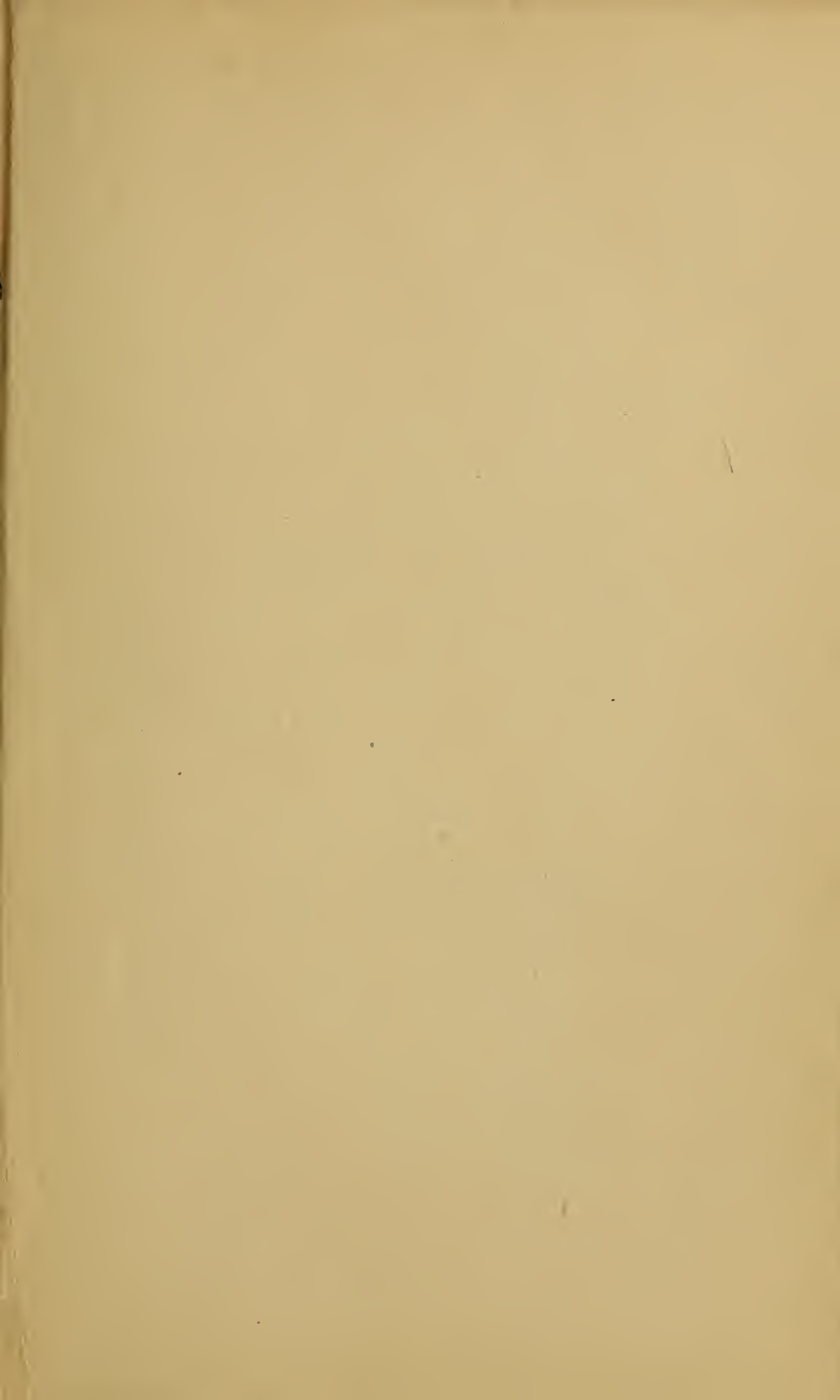












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